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WXES3182: Projek Latihan Ilmiah II

Student Information System
(Online Course Registration System)

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ABSTRACT

This Student Information System (SIS) will be developed with the objectives of utilizing the computer and information technology to provide an easy and convenient online course registration system for the Faculty of Computer Science and Information Technology. This system promises a new dimension, which transcends across time and space. Time and space no longer are barriers. Students can register their courses at a different location and at a different time zone.

SIS is a web-based application that uses to keep track of students' information. SIS consists of two sections that are student section and administrator section. Student section will be developed using Active Server Pages and scripting language technologies. Students' tasks will be implement on the web that enables them to register their courses online through Internet. Meanwhile, the administrator section will be developed using Visual Basic 6.0 as a non web-based application. The purposes are to maintain a secure environment and reduce processing time. This section will provide the administrator with facilities to control the registration process. The system also manages to do checking and validation on the students' registration, which will reduce enormously the administrator workloads.

SIS is a stand-alone system. It will be developed on the Microsoft Windows NT Server 4.0 platform utilizing database that will be created and stored from Microsoft SQL server. Internet Information Server will be used as web server while Visual InterDev 6.0 will be used as a tool for designing dynamic web application for this project. It is believed that the system will gradually become an essential to everyone in the future.

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Chapter 1: Introduction

1.1 PROJECT OVERVIEW

This Student Information System (SIS) is a web-based application that uses to keep track of student information. This information can be categories as personal information, academic information and non-academic information. It also enables the faculty to analysis student's performance and generates reports for internal information purpose. The system will consists of 3 sections which are student section, administrator section and lecturer section. It will implement student's tasks on the web while administration's tasks on the client/server application. Lecturer's tasks will be implemented on the web.

Under this Student Information System, there is an Online Registration System that provides facilities to the students to register their courses online. This Online Registration System consists only 2 sections which are student section and administrator section.

The main benefit of the system is to provide greater conveniences and greater accessibility to the students. For the Online Registration System, its student section comprised of 3 modules while its administration section comprised of 4 modules.

The student section of the Online Registration System comprised of the following modules:

- student online course registration
- course information
- student personal data management (including login password and maintenance)

The administration section of the Online Registration System comprised of the following modules:

- student online course registration management
- management

- administrator personal data maintenance (including login password and maintenance)

This Student Information System is develops purposely for the Faculty of Computer Science and Information Technology under the e-Faculty project. It will be developed based on the university and faculty rules and regulation. The system will benefit the Faculty of Computer Science and Information Technology.

1.2 PROJECT OBJECTIVES

The main objective of this project is to develop a web-based student information system. In more specifics, this project will develop a student course registration system. The objectives of the project are listed below.

1) **Provide better information to meet student need**

   Students will get the full detailed information of their registration. Current information or update information can be preview by students just on their monitor screen.

2) **Create a paper-less environment**

   Most of the information or records, which are kept in files, will be kept in the computer storage.

3) **Save students' time**

   Students will no longer need to queue up for getting their registration forms or results. With this SIS, students can preview their results or register their subjects or courses online at anytime and anyway.

4) **Efficient utilization of personal**

Less personal will be involved in the course registration process if the system is implemented. Only one or two administrators will be needed to maintenance and control the registration process.

5) **Reduce data recording and manipulating errors**

Tasks, which are done manually, will be done automatically by the system. This will be able to reduce errors in doing data recording or some data calculation.

6) **Increase efficiency in management operation**

This automated system will increase the efficiency in operating tasks.

7) **Produce and utilize information to meet proper planning**

The system is enables to do analysis on the student's performance. This information may be useful to do a proper planing for the future.

8) **Provide easy access information for student and other user**

Students no longer need to look for the administrator for the subjects or courses information. This information can be access by students through Internet. They may access it at anytime and anyway.

9) **Improve services**

Any request for information or records can be done very quickly since the information or records have been stored in a systematic way.

1.3 PROJECT GOAL

In order to overcome the current system's lacks and provide a systematically education system, this project is need to be implement urgently. The main goal is to help the university to achieve e-university status generally and help FSKTM to achieve e-faculty status specifically.

1.4 PROJECT SCOPE

Figure 1.1 below depicts an Online Course Registration Environment Conceptual Framework.

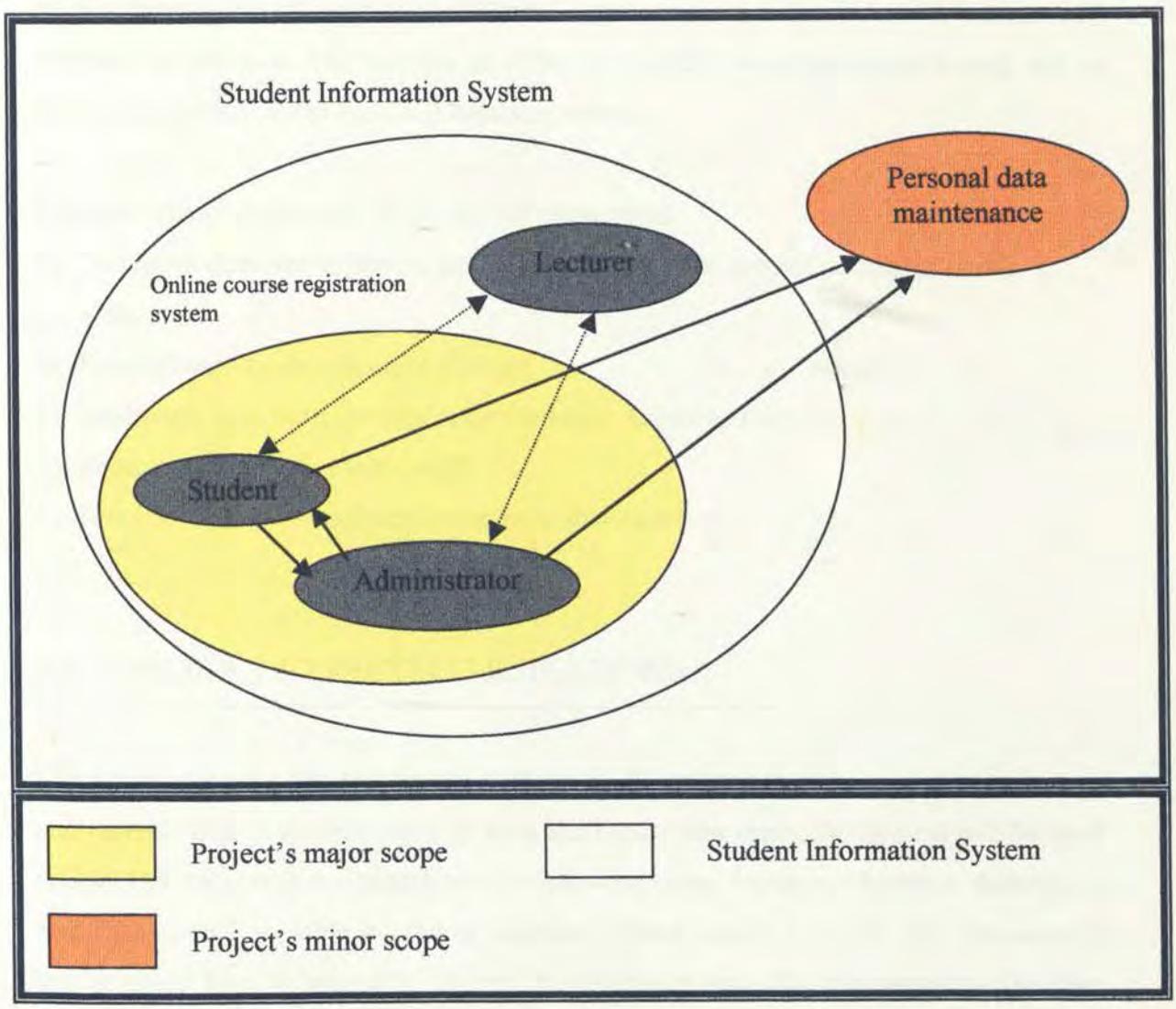


Figure 1.1: Online Course Registration Environment Conceptual Framework

The scope of the SIS covers three main categories that are students, administrator and lecturer. However for the Online Course Registration System, it covers two main categories which are student and administrator.

In the students' section, users are allowed to access the facilities provided in the Student Information System. The services provided are such as online course registration system and personal data maintenance.

In the administrators' section, authorized administrators are allowed to access and maintain the database. The function provided is to enable the administrator to add, edit or delete the program at the back end database system.

This web-based system will cover the following areas:

1) Develop a database system to keep track of all data or records pertaining to the system
2) Provide features for reporting printing
3) Implement password protection for authorize access by user
4) Implement interactive web pages
5) Provide interface for administrator to do maintenance

1.5 PROJECT EXPECTED LIMITATIONS

The target users for this system are students as the main user, lecturers, administrators and parents. Due to the limitation of time and human resources, this system will be used in FSKTM only with no integration or link with other faculties. However students in FSKTM are still available to register subjects offered outside FSKTM. The limitation is that students have to manually register their subjects with the corresponding faculties before summit theirs course registration via this proposed system.

1.6 PROJECT EXPECTED STRENGTHS

This project is expected to possess a few strengths that enable to improve or overcome our current problems. Its expected strengths can be categorized and are listed below.

Friendly User Interface

This system is expected to possess a friendly user interface that is easy to use. GUI components such as command buttons, check boxes and radio buttons are used to attract the users to navigate through the system. Authorized users are able to easily locate the system's functions through menu.

Easy Accessibility

This system could be accessed easily using the Web browser where it could be downloaded free from any authorized web site.

Relatively Fast Response Time

This system will be designed in such a manner that its web pages are loaded in a reasonable amount of time. This is to ensure that users do not need to wait to long to view the pages.

Enforce Different Access Level

This system is expected to enable administrators to have different access level. This is to provide a better secure environment among administrators.

System Validation

This system is expected to provide a validation system. It enables to validate student course registration based on faculty and university registration rules and regulations.

Password Encrypted Site

This system is expected to been secured by an encrypted technology.

1.7 PROJECT SIGNIFICANCE

This project is significance since the numbers of students enrolled in FSKTM are consistently increasingly. The numbers of courses or subject offer in FSKTM are also

following this trend. These make the student registration process getting more and more complicated. It would be in a difficult task to solve this problem manually. With this system, most of the tasks will be done automatically. This will probably make the process functioning more effectively and efficiently. Furthermore, if the university wish to achieve the e-University status, automate system is a must.

1.8 PROJECT EXPECTED OUTCOME

The outcome that is expected from the complexion of the web-based Student Information System is an on-line course registration system for the students of the Faculty of Computer Science and Information Technology. The system consists of two main categories – student and administrator.

1.9 PROJECT SCHEDULE

Figure 1.2 below depicts on the project schedule for SIS.

Web-based Student Information System Project Schedule (Jun 2000 – February 2001)									
Activities	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
PHASE 1									
Literature Review									
Draft Proposal									
System Analysis & Design									
Prototyping									
Proposal Writing									
PHASE 2									
System Design (Complete)									
Coding									
Testing									
Report Writing									

1.10 REPORT OUTLINE

The purpose of this report is to document essential information gathered and implement throughout the development of the project. It covers the project literature review and analysis and partial of the design of the software. This report is divided into four chapters, which are described as follows:

Chapter 1: Introduction

This section gives overview of the project and the objectives, scopes, limit, goal and significance. This section also consists of the project planning and its expected outcome.

Chapter 2: Literature Review

This section explains the studies done – analysis and synthesis, section by section, for the Student Information System. It includes details of the field that the study has involved. It covers the survey on current conventional education system and several online systems. It too describes several methods and consideration on programming tools used, database implementation, operating systems preferences, server selection and other technologies that related to SIS. Several strategies to develop a successful SIS also included.

Chapter 3: System Analysis

This chapter describes the analysis has been done since the project started. It includes analysis on the current education system in University Malaya generally and the current course registration specifically. It also includes functional and non-functional requirements of the system based from the requirement analysis in system development life cycle. This chapter also concludes the methodology used for this project plan.

Chapter 4: System Design

This section describes the consideration for the input design, output design and database implementation into the system development.

Chapter 2: Literature Review

2.1 PURPOSE OF THE LITERATURE REVIEW

The main purpose of the literature review is to guild the students or researchers using the best way to access and analysis information regarding their research topic. It also helps the students to recognize relevant information and synthesize and evaluate it according to the guiding concept. It helps students to develop their information seeking and critical appraisal skill.

2.2 TECHNIQUES ON CONDUCTING LITERATURE REVIEW

Information is essential to do a good research or analysis. For this project, several techniques have been taken to seek information. These techniques are as follow.

- **Refer to reference books from the library**
  A lot of references on conference, workshop, journal and symposium can be found from library. References book on methodology and system design also can be found from the library.

- **Search information from the internet**
  Internet is the main source of information. Relevant information on web application, client-server and programming tools are analyzed. Current online Student Information System also can be viewed and compared.

- **Do analysis on the pass year thesis**
  Several pass year thesis documentation have been studied in order to identify any potential mistakes and gain some skills on software development.

- **Refer to newspapers and magazines**

  Reference on the latest newspaper and magazine such as In Tech (The Star), CompuTimes (New Straits Times) and PC Magazines is one of the techniques to gain the latest technology for this project.

- **Have discussions with friends and lecturers**

  Useful advises have been given for each section meeting conduct with my supervisor and other lecturers. It is a useful for error correctness and act as reminder when carried out the system development process.

- **Conducting interview and survey**

  Interview and survey have been conduct with administrators and students to find out the lacks of the current system and potential improvement on it.

2.3 CURRENT ONLINE STUDENT INFORMATION SYSTEM

2.3.1 THE FACULTY OF INFORMATION TECHNOLOGY

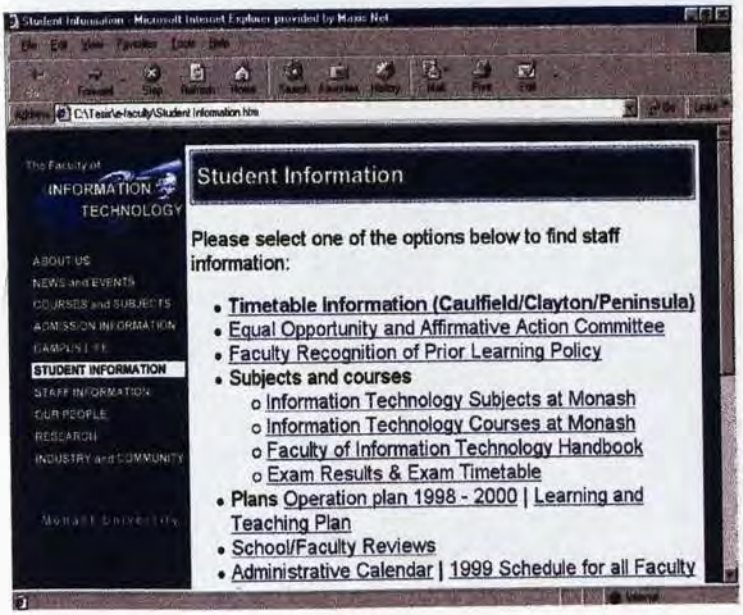


Figure 2.1: Faculty of Information Technology Main Page

Monash University is a dynamic and well recognize university. It also has many branches throughout the word and one of its branches has been established in Malaysia.

The Faculty of Information Technology of Monash University site is well organize and design in term of look and feel. This page is well implemented in event handling which provides a unique linking menu. It also has an attractive layout. This site consist of ten sections which are About Us, News and Events, Courses and Subjects, Admission Information, Campus Life, Student Information, Staff Information, Our People, Research and Industry and Community. Every section has its own functions. For the News and Events section, it provides the latest information regarding the information field or some past conferences. Its information is categorized into Current News, Special Event, Resent Past and Archive [Monash University, 2000].

Meanwhile Student Information section consists of timetable information for courses schedule and exam schedule. It also consists of an administrative calendar and linking to the university and the centres. All subject and courses information will be available through the subjects and courses section.

2.3.2 UNIVERSITY OF FLORIDA

Figure 2.2: Integrated Student Information System Main Page

University of Florida is one of the best universities in the United State of America. It site is well design and has series of attractive web pages. The site consists of four main modules, which are Admissions, Records and Registration, Integrated Student Information System (ISIS) and Site Map. Each of the modules is represented by an icon.

Admissions module is not for the University of Florida's student and for those would like to access information and enroll in this university. Records and Registration is for the current and former University of Florida's student who need information regarding the courses schedule, transcripts, catalogs and others. ISIS is for the current student to register for classes, get grades, checking financial aid, degree shopping and others. Meanwhile Site Map module is for those who already know what the need to look for. They can directly access the relevant information through this module.

Among the four modules, Integrated Student Information System is the most interesting and powerful module. It consists of six sections, which are Registration, Grades, Schedules, Make Payments, ISIS Administration Application and More ISIS Services. Registration section and Schedules section have fall, spring and summer option. The Grades section is only for students to access or preview their marks. Meanwhile Schedules section is for students to look for courses or subjects that available to register for the particular semester through the Registration section [University of Florida, 2000].

The Make Payment section is a very complex and advance feature that enables students to pay their fees through their account. Nevertheless they need to have a GatorLink account in order to use the ISIS and other University of Florida services. University of Florida also provides a login feature for the authorized user to access the database.

2.3.3 THE E-COLLEGE.COM

The e-College main page is shown in Figure 2.3.

eCollege.com is a online courses and degree programs provider at America's finest colleges and universities. It provides solutions and technologies to enhance the higher education institution learning and teaching style The OnLine Learning 2000 Conference and eCollege.com welcome the higher education community to build partnerships with corporate trainers in the design and delivery of eLearning. This presents an opportunity to tailor online programs for corporations. It also provided facilities to build an own online course or supplement using eCollege.com's eTeaching Solutions, which make online course authoring easier than ever [eCollege, 2000].

Meanwhile eCollege.com also brings technology into classroom and student can currenly receive a graduate degree online using audio, video, virtual classroom, graphics and images with slide show [eCollege, 2000].

Some of the Web-based education technology products and services by e-College.com including New CampusPortal 4.0, New eTeaching Solutions 4.2, Ecourse, Ecompanion and EtoolKit [eCollege, 2000].

2.3.4 UNIVERSITY TUN ABDUL RAZAK (UNITAR)

Figure 2.4: UNITAR Main Page

University Tun Abdul Razak (UNITAR) is Malaysia's first virtual university and the only one provides certain program registration and enrolment application through web. The learning process in the Business Administration program for UNITAR is designed around the use of a unique learning and instructional model through interactive multimedia software and the University's Intranet. Key instruction design components include independent study, on-line interaction and virtual classrooms, homework assignments via e-mail, video/computer conferencing, study teams, self-evaluation and quizzes and graded examination [UNITAR, 2000].

In order to complement the on-line mode of instructions and lesson delivery, UNITAR is establishing several study centers and satellite study centers in various parts of the country. The study center will serve as a center for learning and social activities and will be link through local area network (LAN) and wide are network (WAN). These study centers will be furnished with high-end multimedia workstations, virtual library systems, video conferencing, language laboratories, creative development facilities and seminar and discussions rooms. The first study is located at Kelana Jaya, Petaling Jaya.

These satellite study centers, furnished with similar facilities and infrastructure as the study centers, provide the support needed by students on a smaller scale. These satellite centers will also be linked to UNITARnet and Internet [UNITAR, 2000].

2.3.5 SMART EXTENDED EDUCATION (SEED)

Figure 2.5: Smart Extended Education Main Page

Seed is well arranged and provides three types of access levels that is administrator, instructor and students. Extra section, which named as Bookstore users is included too to make the site more functionality.

The system is very flexible thus enabling students to master Seed and benefit from the application. Students are able to communicate better with their instructors by having the flexibility of scheduling meeting, posting messages in the forum and even download materials. Seed gives students the freedom to be independent and to be able to work at their own pace. Some are slow learners while others catch things at a faster pace. So, by using Seed, students that are left behind can catch up and also get personal attention from the instructors [SEED, 2000].

This Seed is made user-friendly and easy to master. Administrator can work from anywhere as long as there is Internet connection and a browser to access the server for monitoring of the system and maintaining the contents. In Seed, the administrator's role is divided into two groups; Administrator and Management. Administrator section allows maintaining website contents, maintaining the collaboration tools, document management (Library), registering of courses, multimedia lecture setting, chat server and year setting. Meanwhile, administrators can manage instructors database, manage students database and profiles, control bookstore users, maintain departments in the system, resource management, set the time frame for each semesters, standardising of faculty, evaluation questions [SEED, 2000].

With Seed, instructors are able to interact with their students through real-time chat and reach out to more students. This will create a closer knit relationship between instructors and students and vice versa. Instructors of Seed are capable of maintaining the classroom, the students' grades either manually or automatically, put in the course content to be used by any registered students and even schedule meeting to see students personally.

2.3.6 MAHIRNET

Figure 2.6: MAHIRNET Main Page

Mahirnet Sdn. Bhd. is a joint venture between Telekom Malaysia and Melewar Academic Holding Sdn. Bhd. It is a technology enabler for Malaysian universities for the development of online learning programs. It also promotes in Malaysia online programs of selected international universities [MahirNet, 2000].

Mahirnet.com has attractive web page layout and acceptable download time. In terms of student's section, the site is well categorized into four components. The first part is Schedules. It lists out the curriculum and course schedule for the individual student. It also has a calendar form which sets out course assignments and due dates and examination dates. Its MediaCenter is an on-line university library, filed with reference materials, graphics, audio and video files and links to websites of interest. Others are CourseRoom which acts as a virtual classroom and profiles page where students can build personal homepages for each other to visit [MahirNet, 2000].

Mahirnet protect customer by using the encryption technology, digital certificates, secure commerce servers and authentication to ensure that every personal information is secure online. Beside, it is developed using Lotus Notes and makes use of the tool's advantages such as offline transaction and suitable for work flow system. This site also provides loan for on-line learning from Bank Rakyat. Although Mahirnet is not a university but it is more like a gourment platter of university courses [MahirNet, 2000].

2.3.7 CONCLUSION OF THE ONLINE STUDENT INFORMATION SYSTEM

Even there are many online learning system such as Mahirnet, UNITAR, University of Florida and SEED but not all of them provide on-line registration feature. Those who provide this feature are such as University of Florida and UNITAR. However this on-line registration system can be categorized into two categories such as for new admission and for course registration. Anyway this two categories have the almost some procedures.

Many of the learning system use Active Server Pages as their development tools. Some provides attractive web site and acceptable download time. The most suitable references site are Monash University and University of Florida. Manash University is chosen because of the module features in its Faculty of Information Technology which are similar with SIS. It has a subjects and courses section where all the courses and subjects information are available through this section. Meanwhile University of Florida is chosen because of its powerful Integrated Student Information System (ISIS) which is quite similar with SIS. It has three important modules which are Registration, Grade and Schedule module that its features and functionality can be useful to SIS.

Although all learning web sites have their own lacks and strengths, few criteria should be considered. The criteria are performance, security, user-friendly interface, functionality, feasibility and reliability. SIS should adapts their strengths and overcome their lacks in order to provide better service to the users of this system.

As a conclusion, in order to meet future needs, higher education institutions should:

- Encourage life long learning in post secondary education
- Allow students to receive their education any time and any way via technology
- Require collaboration with business and industry in developing relevant curriculum
- Integrate applied or on-the-job experience into academic programs

2.4 CLIENT/SERVER COMPUTING

2.4.1 INTRODUCTION

Client/Server is a software partitioning paradigm in which a distributed system is split between one or more server tasks which accept requests, according to some protocol, from (distributed) client tasks, asking for information or action (Maggie, 1995). There may be either one centralized server or several distributed ones. This model allows clients and servers to be placed independently on nodes in a network.

A client is the requesting program or user in a client/server relationship. The user of a web browser is effectively making client requests for pages from servers all over the web. Meanwhile the browser itself is a client in its relationship with the computer that is getting and returning the requested HTML file. The computer handling the request and sending back the HTML file is a server.

In general, a server is a computer program that provides services to other computer programs in the same or other computers. The computer that a server program runs in is also frequently referred to as a server (though it may contain a number of server and client programs).

The premise of client/server computing is to distribute the execution of a task among multiple processors in a network. Each processor is dedicated to a specific, focused set of subtasks that it performs best, and the end result is increased overall efficiency and effectiveness of the system as a whole. Splitting the execution of tasks between processors is done through a protocol of service requests; one processor, the client, requests a service from another processor, the server. The most prevalent implementation of client/server processing involves separating the user interface portion of an application from the data access portion.

On the client, or front end, of the typical client/server configuration is a user workstation operating with a Graphical User Interface (GUI) platform, usually Microsoft Windows, Macintosh, or Motif. At the back end of the configuration is a database server, often managed by a UNIX, Netware, Windows NT, or VMS operating system.

2.4.2 EVOLUTION OF CLIENT/SERVER COMPUTING

In the 1970's, departmental managers found that relying on central mainframe-based applications hindered their ability to rapidly respond to business demands. Application development time within the central information system (IS) was too slow, and the result was not tailored to the specific needs of a department [William, S, 1994]. Though the deployment of PCs enabled workers have computing power and data at their command and enabled department-level managers to select needed applications quickly, this has its drawback.

In a pure PC environment, cooperation among users was difficult. Even within a department, there needed a departmental-level database and departmental formatting and data usage standards. The solution to these requirements is departmental–level client/server architecture. The success of departmental architecture paved the way for the enterprise-level client/server computing.

The dominant theme of such architectures is the reestablishment of control over data by the central IS organization but in the context of a distributed computing system, hence enter the client/server computing concept. Today, the most common type of server is the database server, besides as data as a storage it also handles requests and responses from the clients.

2.4.3 CLIENT/SERVER COMPUTING MODEL

Gartner group came out with the five ways of describing the different client/server styles based on how they split the three components of any application: user interface, business

or application logic, data management. The five styles are distributed presentation, remote presentation, distributed function, remote data management, and distributed data management. Shown below is the client/server computing are modeled based on Tan from IBM.

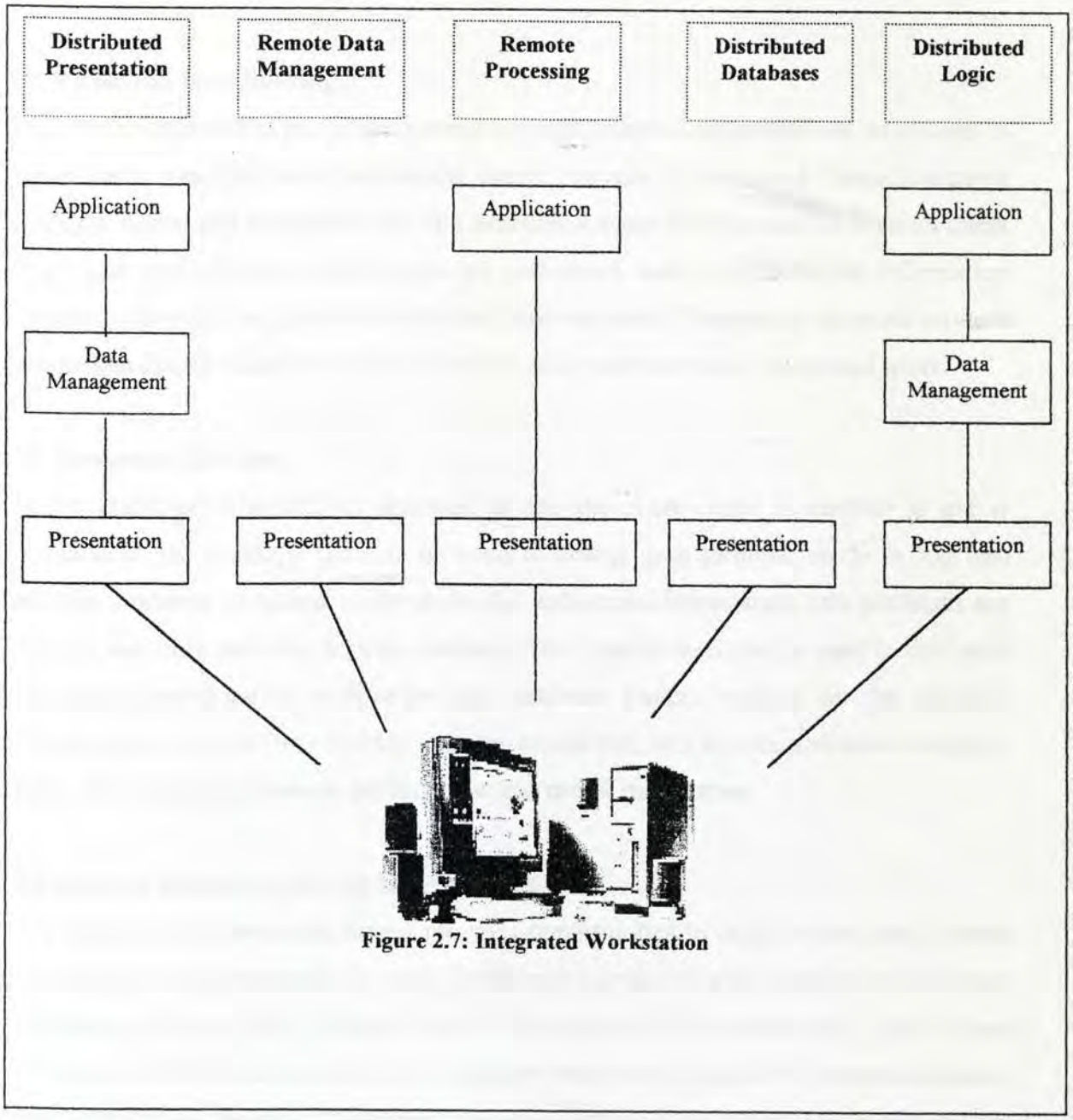


Figure 2.7: Integrated Workstation

2.4.4 ADVANTAGES OF CLIENT/SERVER COMPUTING

Client/server computing model provides the means to integrate personal productivity applications for an individual employee or manager with specific business data processing needs to satisfy total information processing requirements for the entire enterprise.

✉ **Enhanced Data Sharing**

Data that is collected as part of the normal business process and maintained on a server is immediately available to all authorized users. The use of Structured Query Language (SQL) to define and manipulate the data provides support for open access from all client processors and software. SQL grants all authorized users access to the information through a view that is consistent with their business need. Transparent network services ensure that the same data is available with the same currency to all designated users.

✉ **Integrated Services**

In the client/server model, all information that the client (user) is entitled to use is available at the desktop. There is no need to change into terminal mode or log into another processor to access information. All authorized information and processes are directly available from the desktop interface. The desktop tools can be used to deal with information provided by application and database servers resident on the network. Desktop users can use their desktop tools in conjunction with information made available from the corporate systems to produce new and useful information.

✉ **Sharing Resources Among Diverse Platforms**

The client/server computing model provides opportunities to achieve true open system computing. Applications may be created and implemented without regard to the hardware platforms or the technical characteristics of the software. Thus, users may obtain client services and transparent access to the services provided by database, communications, and applications servers. Operating systems software and platform hardware are

independent of the application and masked by the development tools used to build the application.

✉ **Data Interchangeability and Interoperability**

Almost all the development tools used for client/server development expect to reference a back-end database server accessed through SQL. Network services provide transparent connectivity between the client and local or remote servers. Systems developers are finally reaching the point at which this heterogeneity will be a feature of all production-class database engine products. Most systems that have been implemented to date use a single target platform for data maintenance. The system development environment (SDE) and tools must implement the interfaces to the vendor database and operating system products. It provides the capability to make ad hoc requests for information.

✉ **Centralized Management**

As processing steers away from the central data center to the remote office and plant, workstation server, and local area network (LAN) reliability must approach that provided today by the centrally located mini- and mainframe computers. The most effective way to ensure this is through the provision of monitoring and support from these same central locations. A combination of technologies that can "see" the operation of hardware and software on the LAN; monitored by experienced support personnel which provides the best opportunity to achieve the level of reliability required.

2.4.5 CLIENT/SERVER ARCHITECTURE

The client/server architecture has been called the model of computing of the 1990s.

With this architecture, the calling module becomes the "client" (that which requests a service), and the called module becomes the "server" (that which provides the service). This is usually result in putting the processing to the user or client machine and the data management and storage server. Depending on the application and software used, all data processing may occur on the client or split between the client and the server. The server

is connected via a network. Server software accepts data from client and then return with results to the client. The client manipulates the data and presents the results to the user.

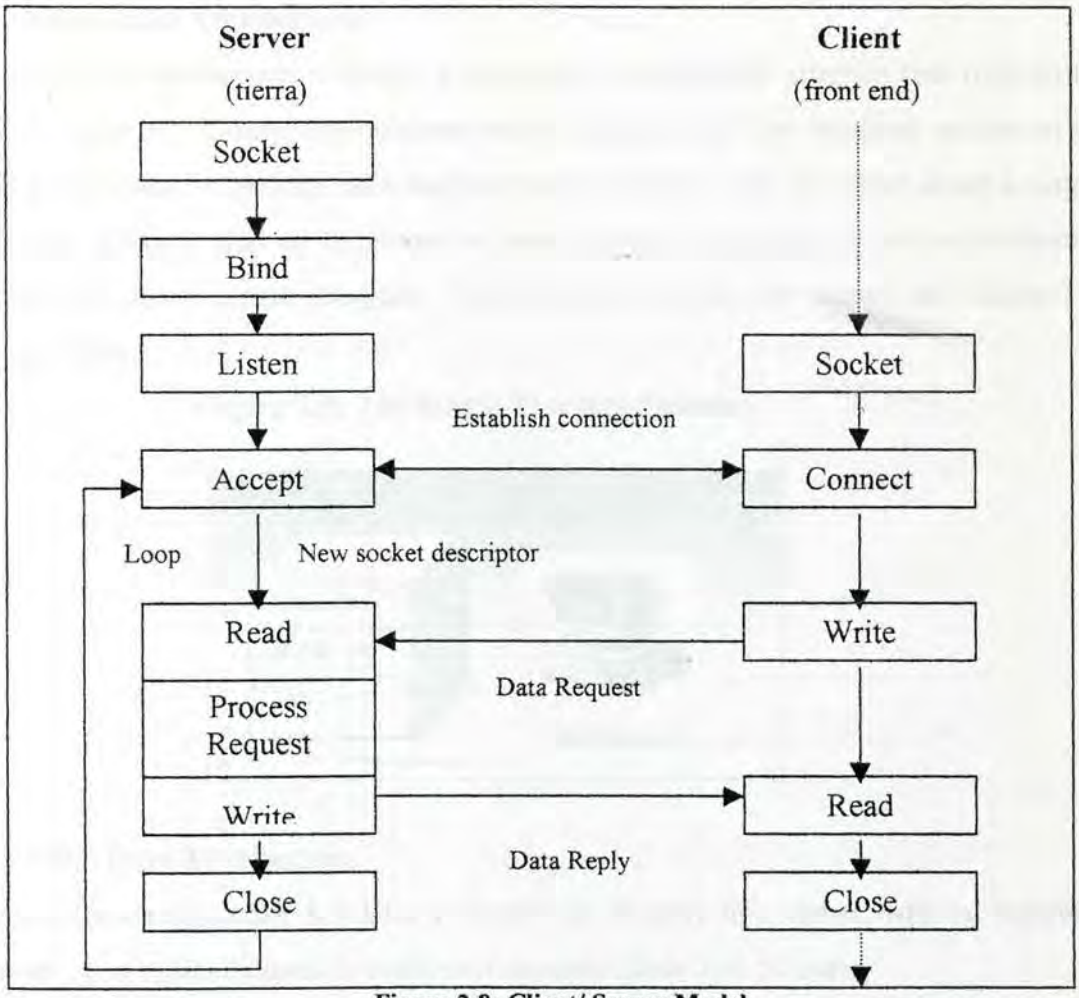


Figure 2.8: Client/ Server Model

In the ever-changing environment, the architecture of applications, especially large enterprise, mission-critical ones, have evolved from single-tier to n-tier designs. The primary concerned issues for this change are scalability, separation and encapsulation of functionality, maintainability, multi-user support, and the ability to be distributed.

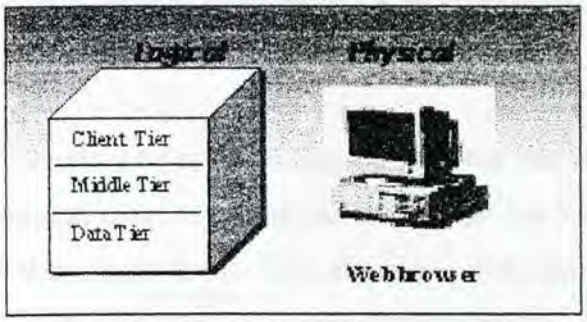
The three types of tiers are generally described as client (first or presentation), middle (second or business or functionality), and data (third) service tiers. The concept of tiers

emphasizes the logical segmentation of the services, and is neither about implementing the services nor about the number of physical computers involved in deploying the solution.

- **Single-Tier Architecture**

A single-tier application is simply a monolithic, stand-alone program that runs on the user's computer. It may communicate with a database, but that database resides on the same computer (or perhaps on a mapped network drive). The key point about a single-tier application is that all three tiers — user, business, and data — are architecturally combined into a single program. The following Figure 2.9 shows the Single-Tier Applications:

Figure 2.9: The Single-Tier Applications



- **Two-Tiers Architecture**

A two-tiers architecture is where a client talks directly to a server, with no intervening server. It is typically used in small environments (less than 50 users).

In this environment, much processing is performed on the client workstation, using the memory space and processing power of the client to provide much of the functionality of the system. Field edits, local lookups, and access to peripheral devices (scanners, printer, and so on) are provided and managed by the client system. Since almost all processing is done at the client, the client portion is sometime refers as fat-client.

A common error in client/server development is to prototype an application in a small, two-tier environment and then scale up by simply adding more users to the server. This

approach will usually result in an ineffective system, as the server becomes overwhelmed. To properly scale to hundreds or thousands of users, it is usually necessary to move to a three-tier architecture.

- **Three and Multi-Tiers Architecture**

A three-tier architecture introduces a server (or an "agent") between the client and the server. The role of the agent is manyfold. It can provide translation services (as in adapting a legacy application on a mainframe to a client/server environment), metering services (as in acting as a transaction monitor to limit the number of simultaneous requests to a given server), or intelligent agent services (as in mapping a request to a number of different servers, collating the results, and returning a single response to the client. The movement from two-tier architecture to three-tier or multi-tier architecture due is to the needs for a scalable and maintainable system and the wide variety of clients within a larger organization.

In multi-tier architecture, as shown below, each of the major pieces of functionality is isolated. The presentation layer is independent of the business logic, which in turn, is separated from the data access layer. This model requires much more analysis and design on the front-end, but the dividends in reduced maintenance and greater flexibility pays off. This model exhibits a much thinner client by bringing some processing tasks back to the server.

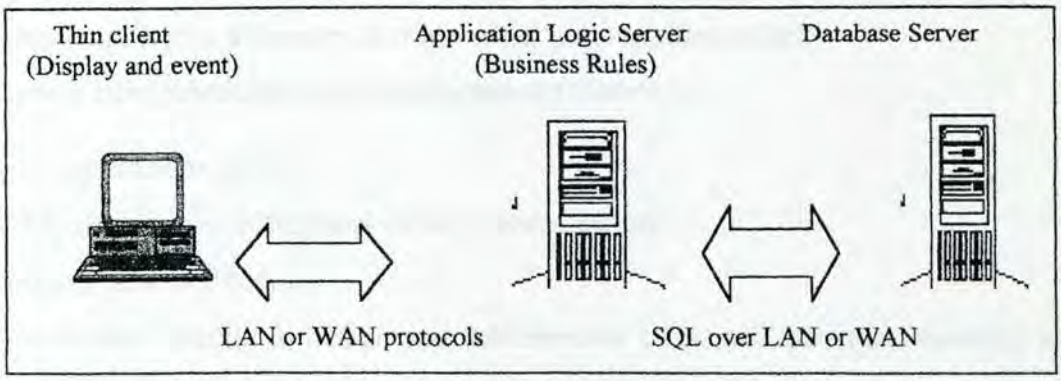


Figure 2.10: Three-Tiers Architecture Application

2.4.6 CLIENT/SERVER ENVIRONMENT

The 3 components of a N-tier client/server environment are presentation, business logic or functionality, and data. They are separated such that the software for any one of the pieces (tiers) could be replaced by a different implementation without effecting the other tiers.

The environment of client/server architecture can be view from logical and physical perspective. The logical perspective is a conceptual way of thinking that helps us to plan and understand the application model without knowing clear about where the application model is physically resides. While the physical perspective primary concern about the distinct place where the application model resides.

Presentation tier (or user interface) is a front-end tool with which the end users interact. It may take the function of any types of user interface, such as Visual Basic Application, or a web browser. It consists of hardware such as a PC or workstation.
Functionality tier (also known as processing tier) represents most of the logic that make the applications functional. This tier provides functionality, connectivity, and database servers. It also provides the bridge between the first and third tiers.

Data tier is a storage mechanism for holds a persistent data. This tier may include existing systems, applications, and data that have been encapsulated to take advantage of this architecture with a minimum of transitional programming effort.
With these 3-tier architecture application, you are allow to:

- Build applications rapidly
- Modify them easily as business circumstances dictate
- Evolve to new architecture
- Involve users directly in design and development to ensure maximum usability and effectiveness"

2.4.7 CHARACTERISTIC OF CLIENT/SERVER ARCHITECTURE

The basic characteristics of client/server architectures are:

1. Combination of a client or front-end portion that interacts with the user, and a server or back-end portion that interacts with the shared resource. The client process contains solution-specific logic and provides the interface between the user and the rest of the application system. The server process acts as a software engine that manages shared resources such as databases, printers, modems, or high powered processors.

2. The front-end task and back-end task have fundamentally different requirements for computing resources such as processor speeds, memory, disk speeds and capacities, and input/output devices. The environment is typically heterogeneous and multi-vendor. The hardware platform and operating system of client and server are not usually the same. Client and server processes communicate through a well-defined set of standard application program interfaces (API's) and RPC's.

3. An important characteristic of client-server systems is scalability. They can be scaled horizontally or vertically. Horizontal scaling means adding or removing client workstations with only a slight performance impact. Vertical scaling means migrating to a larger and faster server machine or multi-servers.

2.4.8 TRANSITION OF CLIENT/SERVER TO WEB-BASED SYSTEM

The most significance difference between these two approaches lies in the promise for the future and how each adapts to industry directions and trends. With the web-based architecture, the role of the client (browser) and the server, when designed correctly can also provides the best of the traditional client-server architecture.

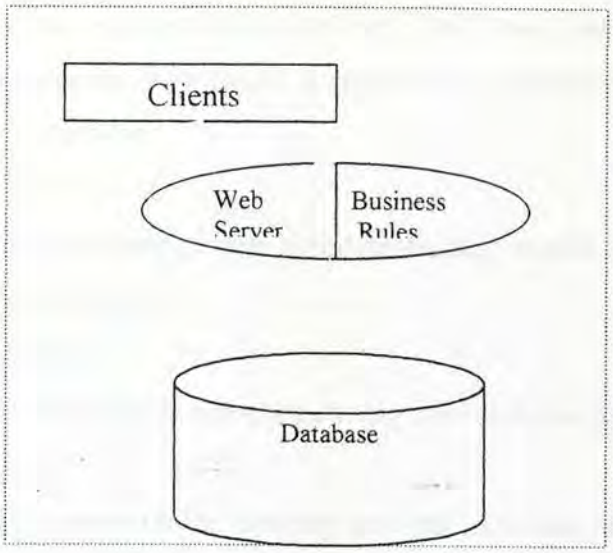


Figure 2.11: Web-Based Application

Difference Between Client-Server Architecture and Web-Based Architecture

- **Adaptability**

Client-Server systems cannot easily take advantages of new technologies such as network computers, Intranet and Java. Web based applications which is rendered in Java/Active-X form represent a retreat toward centralized computing, away from the empowering effect of desktop computing.

- **A Much Thinner Client**

A classic application results a fat-client where a web-based application results a much thinner client, the thinnest being using pure HTML on the application. Fat client software means added complexity which allows it to handle more processing and is more error prone while a web server client(browser) fails less often and is much more reliable.

- **Ease of Maintenance**

Client-Server system requires excessive time and expenses for the installation and upgrades. As in contrast to web-based, it requires less installation on the client. The only necessity is the web browser.

From a networking standpoint, a web-based application means:-

- less complicated software
- better performance
- the possibility of bringing some interesting new technologies such as network cards into the company.
- Puts computing power on the desktop and lets user have a clearer view of how the application is behaving.

2.4.9 REVIEW ON CURRENT CLIENT/SERVER ARCHITECTURE

	Two-tier	Three-tier	Multi-tier
Level of layer	Two	Three	Multi
Easy to develop	Very easy	Difficult	Very Difficult
Flexibility and scalability	Low	High	Highest
Fat-client	Yes	No	No
Require powerful client (memory, etc)	Yes	No	No
Volume of result sets generated by server	Large	Reasonable	Reasonable
Cost of development and support to deploy the business rules on the client	Very high	Reasonable	Cheaper
Total of tasks to undertake and complex issues to address	Fewer	Many	Much
Required separate database connection per workstation	Yes	No	No

Table 2.1: Client/Server Architecture

2.4.10 REVIEW OF CLIENT/SERVER VS WEB-BASED DEVELOPMENT

Table 2.2: Client/Server vs Web-based Development

	Client/Server	Internet	Intranet	Extranet
Browser Enabled?	No	Yes	Yes	Yes
User Interface	GUI	GUI	GUI	GUI
Performance	Good	Dependent	Good	Good
Security	Yes	Yes	Yes	Yes
Network	Finite	Infinite	Very Scaleable	Very Scaleable
Server Platforms	All Servers -- Company paid	All Servers -- Great Flexibility	All Servers -- Great Flexibility	All Servers -- Great Flexibility
Client Platforms	Mostly PCs	*Any* GUI Platform	*Any* GUI Platform	*Any* GUI Platform
Ease of Development	Extremely Complex	Complex	Complex	Complex
Migration Issues	Complex	Moderate	Moderate	Moderate
Cost	Expensive	Expensive	Expensive	Expensive
Maintenance	Complex	Simple	Simple	Simple
Client Application Size	Fat, Usually	Skinny	Skinny	Skinny

2.5 WEB-BASED COMPUTING

2.5.1 INTRODUCTION

A clearly understanding of the web-based technology is important in order to develop a successful web-based Student Information System

The Internet

The Internet is a gigantic collection of millions of computers that are all linked together on a computer network. The network allows all of the computers to communicate with one another. A home computer is usually linked to the Internet using a normal phone line and a modem that talks to an ISP (Internet Service Provider). A computer in a business or university has a NIC (Network Interface Card) that directly connects it to a LAN (Local Area Network) inside the business. The entire business then connects its LAN to an ISP

using a high-speed phone line like a T1 line (A T1 line can handle approximately 1.5 million bits per second, while a normal phone line using a modem may be able to handle 30,000 to 50,000 bits per second).

ISPs connect to larger ISPs, and the largest ISPs maintain fiber-optic "backbones" for a nation or a region. Backbones around the world are connected through fiber optic lines, undersea cables or satellite links (refer to Figure 2.12 for a backbone and connection diagram). In this way, every computer on the Internet is connected to every other.

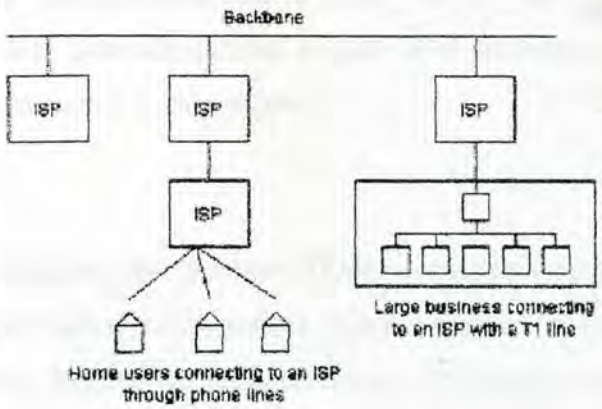


Figure 2.12: Internet Connection

World Wide Web – WWW

The World Wide Web (WWW) is the most popular and notable part of the Internet. The Web is a growing body of millions of documents, or home pages, that contain text, graphical, and multimedia elements. It is relatively easy for anyone-companies, students, and personal users-to publish on the World Wide Web using a page layout language called HTML (Hypertext Markup Language).

The Web is built upon a concept known as hypertext, which allows documents to contain links, which can be selected to access other documents. The client software used to access the WWW is called a "browser", which gives users a graphical user interface to navigate, or browse the Internet rather than use cryptic UNIX commands.

The World Wide Web was developed in 1989 by the European Laboratory for Particle Physics known as CERN in Geneva Switzerland. The successful invention of World Wide Web is due in large part to its creator: Tim Berners-Lee, a computer scientist working at CERN that time. Tim Berners-Lee circulated a paper at CERN called "Information Management:

WWW has 3 elements developed by Tim Berners-Lee. It consists of protocol, domain name and location. It is the protocol of the WWW, the communication between Web servers and Web clients. HTML is the programming language used to instruct Web browsers on how to display information. The World Wide Web is a client-server computing model. Web communications require Web browsers (the client) and Web servers (the server) connected to the Internet.

Web Servers

Web servers are computers that publish HTML documents on the Internet via HTTP protocol. The program called the hypertext transfer protocol daemon which runs on the Web server computers, handles the requests from web browsers and send back requested information.

Web server programs are originally designed for Unix platform. Now they also available on other major computer platforms, including Microsoft Windows, Apple Macintosh OS, and DEC VMS.

One of the important functions of a Web server is to identify the types of specific files by their extensions. The Web server returns the appropriate **Multipurpose Internet Mail Extension (MIME)** type to Web browsers. Web browsers then use the MIME type to determine the file can be process directly, or require an external helper application, or a plug-in program is needed.

Web Servers and the Internet

The browser formed a connection to a web server, requested a page and received it. The browser broke the URL into 3 parts, which are the protocol, the server name, and the file name. The browser communicated with a name server to translate the server name into an IP Address that it can use to connect to the server machine. The browser then formed a connection to the server at that IP address on port 80. Following the HTTP protocol, the browser sent a GET request to the server asking for the file. Cookies may be sent from browser to server with the GET request. The server returned the HTML text for the web page to the browser. Cookies may be sent from server to browser in the header for the page. The browser read the HTML tag and formatted the page onto the screen (Refer to Figure 2.13).

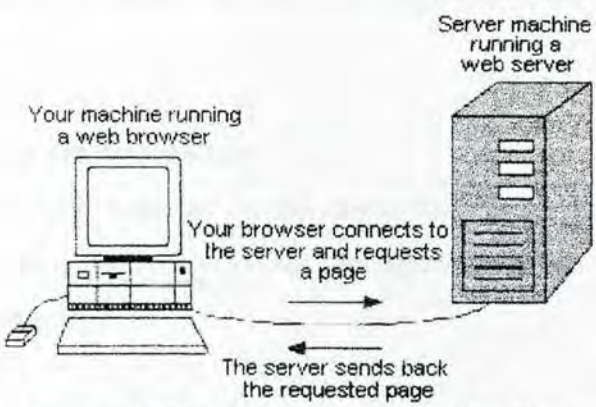


Figure 2.13: Web-Server and The Internet

2.5.2 EVOLUTION OF WEB-BASED COMPUTING

First Generation

The first generation of web browser was only capable of handling text and simple multimedia such as images and sound. Information from a user could be captured by means of simple HTML forms and transmitted to the web server.

The functionally of web server could be extended of the Common Gateway Interface (CGI) that enable the page contents to be personalised for the user and constructed from information stored in the backend databases and applications. The negative side of this first generation is that CGI HTTP will cause a new process to be spawned until the repetition process creations and database opening imposes an excessive overhead on system resources. It is known as static web pages generation.

Second Generation

The second generation started implementation without dull looking, lacking the facilities for user interaction that are accustomed to form typical PC software. It begins active pages enabling user interaction and architecture for distributed client/server processing. This was achieved by the new generation web browser support for downloaded software components, scripting languages and mechanisms for the integration of existing application.

Web-based and Three-tier Architecture

In this architecture, web browser is the client and is responsible for handling the presentation logic that is defined by HTML documents and this may include script logic and software components.

2.5.3 WEB ARCHITECTURE

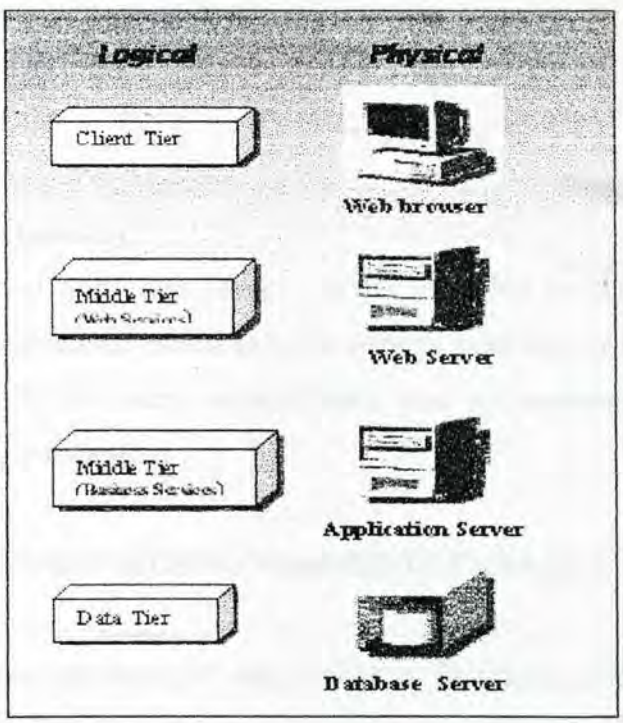
Web architecture can also evolves from the client server application but needs extensive planning and is no simple task. Web application use Internet protocols such as TCP/IP, HyperText Transfer Protocol (HTTP) and Hyper Text Markup Language (HTML) for implementation display and networking protocol to achieve architecture that are robust, scalable and that can accommodate rapidly changing technology.

- **Web-Based Applications**

In a typical web-based application, by its browser/server nature, follow the two- or n-tier model. The application models discussed so far leave a substantial part of the

application on the client workstation. Conversely, applications designed for the World Wide Web place as little of the application as possible on the client, and keep all the processing centralized on one or more servers. The following Figure 2.14 shows the Web-based Applications:

Figure 2.14: The Web-based Applications:



2.5.4 WHY USE WEB DATABASE APPLICATION?

In most web-based applications, database serve as the basic building blocks for information services. Organizations might want to use this database in their web applications for the following benefits:

- **Consolidation of data**

  You may unlock the potential unused information in organization database. Information from database in various part of an organization (for example finance,

human resource, project management and so on) can be consolidated using web-based applications and served to the users as though it were for a simple source. Databases do not have to physically locate in each department of an organization, either.

- **Better manageability**

  The evolution from document-based information repositories to paperless and efficient data storage in web database has save a lot of energy, time and cost in managing records.

- **Extending of functionality**

  The functionality of your web server can be extended so that you can make information you maintained available to the general public or internal users. A task currently undertaken by many organizations and government agencies whose primary product is information.

2.5.5 DESIGN CONSIDERATIONS VIA WEB DATABASE APPLICATION

Designing a Web based database is very similar to designing a database prior to the advent of the Internet. However, there are several issues that must be considered when designing We-based databases. The following is a brief list of issues relating to that:

- **Security** - Secure communications and user identity are critically important for protect the data in the web database from loss, corrupt and unauthorized use. Therefore, you must consider various web technologies and develop a security based on some specific scenario.

- **Performance** – Internet users do not want to have to wait for their queries to process. Any queries that take more than a couple of seconds will probably frustrate the user and possibly cause him or her not to use your Web site. Therefore, you may need to use a denormalized design to achieve acceptable performance.

- **Backup** – The Internet is available 24 hours a day, 7 days a week. Your Web site must be continuously available. This can complicate your backup strategy, which can impact your database design. If you choose to denormalize your design, you may increase the physical size of your database, and this can increase the time frame required to back up your database. The longer it takes to back up the system, the longer the database may be unavailable or unresponsive.

- **Language** – The Internet is worldwide, which means that your Web site may be viewed in foreign countries. Do you need to support multiple languages? If so, this can impact your database design because you need to track data in different languages.

2.6 WEB BROWSER

2.6.1 INTRODUCTION

Web browsers, also called Internet browsers, are the client application programs that run on almost every available graphical user interface (GUI) computer platforms, including Microsoft Windows 3.x, 95, 98, NT and Apple Macintosh OS. Web browsers are multimedia enabled. They can process text, graphics, audio and video, which marked up or embedded in HTML documents. The powerful feature of HTML documents is function of hyperlinks. The appearance of the document varies from browser to browser depending on the capability of each browser, system and preference.

In 1993, a team of student researchers at NCSA released a browser program called Mosaic. This easy-to-use Web client program, available on PC and Macintosh platforms popularized use of the Internet and the Web. Since Netscape Communications Corp. distributed its commercial Web browser - Netscape Navigator freely on the Internet, the huge wave of the Internet growth has changed the way we gather information and the way we do business. Netscape Web browsers: Navigators and Communicators were the

most popular Web browsers on the Internet but Microsoft Web browser: Internet Explorer is gaining major market share nowadays.

Currently, the most popular browsers are Netscape Navigator/Communicator and Microsoft Internet Explorer. The features of browser software have expanded to encompass the ability to access other Internet services in addition to the World Wide Web. The Netscape Navigator and Communicator give a user the ability to read and send e-mail, transfer files (FTP), and read and post Usenet news. Netscape Navigator and Communicator can also be configured to access new media types, such as video, or run other applications within the browser. This is done through Helper Applications or Plug-ins.

2.6.2 COMPARISON BETWEEN NETSCAPE AND INTERNET EXPLORER

Both Netscape Navigator/Communicator and Internet Explorer are the most popular web browsers nowadays. Nevertheless they are different web browsers. Both Netscape and Internet Explorer can be compared with 7 features, which are speed, security, platform support, multimedia, mail and news, look and feel, Java, Intranet, HTML, group

- **Speed**

  Speed is one of the criteria that determine the performance of the browser. There are a large number of factors affecting browser speed. Some things, such as response time from the web server, are beyond the control of the browser. However, the browser can control how efficiently it moves graphics around and how it caches web pages. Loading pages with both text and graphics into the browser when the browser's disk and memory caches were nearly full, Navigator 3.0 was about 35 percent faster than Internet Explorer 3.0 as show in Figure 2.5 (CNET Networks Inc, 2000). Navigator is even faster when its cache is emptied.

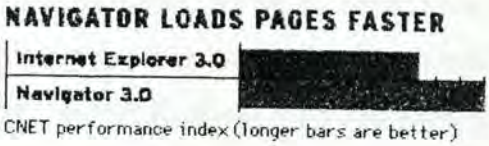


Figure 2.15: Speed Comparison

Internet Explorer is significantly faster at loading large graphics files. It also appears to be more efficient at managing large images that are already in memory.

Navigator 3.0 is noticeably faster at loading most web pages in a high-speed Internet connection. Meanwhile Internet Explorer showed more snap in displaying pages cached in memory.

- **Security**

Both browsers now provide essentially the same level of security for online transactions, supporting Secure Sockets Layer (SSL) versions 2 and 3 and support site certificates. Both also support personal certificates--digital signatures--so that others users can verify the user identity. Perhaps more significantly, they can both now support 128-bit keys for their security codes, providing much stronger security than was possible with 40-bit keys. Both products also can warn users about attempts by a Web server to leave cookies on their system, which can potentially provide personal information to a Web server.

Microsoft has introduced a further level of security with Authenticode, a technology to protect user from potentially malicious downloads of ActiveX controls or Java applets. Internet Explorer also offers support for parental controls and ratings systems (PICS and RSAC) that Navigator does not.

- **Platform Support**

Netscape can justly lay claim to the cross-platform crown. On the day it was released, Netscape Navigator 3.0 supported all flavors of Windows, the Macintosh, and Unix variants such as Solaris and AIX. More importantly, the browser is essentially

identical across all these platforms. However, some features such as the Java just-in-time compiler are currently only available for Windows 95 and Windows NT. Meanwhile Microsoft Internet Explorer only available on specific platform such as Macintosh, Unix and Windows.

- **Multimedia**

Both products support the most popular multimedia data types, such as AVI movies and AU and AIFF sound files. IE has a seamless ActiveX control called ActiveMovie that handles all of its multimedia files. It also supports MPEG, a video format that allows for much smaller files than AVI or QuickTime. And with its support for streaming, ActiveMovie can start playback of a file even before the entire file has downloaded. Navigator has equally broad multimedia support, but it requires separate plug-ins for each format. Navigator 3.0 comes pre-configured with a couple of the more popular plug-ins, including QuickTime and Live3D VRML.

Both products provide basic support for VRML, which creates 3D worlds through which user can navigate. Netscape's implementation was able to handle a wider variety of files than IE. And Netscape has the further advantage that plug-ins are already available from companies such as Silicon Graphics to support recent drafts of the VRML 2.0 standard.

- **Mail and News**

Netscape Navigator 3.0 has mail and news clients in every version. Microsoft's mail and news clients come with every IE 3.0 configuration, except for the minimal install.

The biggest complaint about Netscape mail and news is that the initial configuration of the clients is not a simple task, and, when there is something wrong, all Navigator does to help is pop up an alert box telling that the configuration is in error. Microsoft has a wizard that walks through the process of setting the mail and news servers, online identity, and other chores. Also, Microsoft's mail client offers basic rules and filtering for incoming messages, while Netscape's does not.

While Netscape's mail send and view HTML pages directly in a mail message, the mail editor don't support HTML formatting for the body of the message. Microsoft mail has HTML editing built in, but it only lets simple formatting such as boldfacing or centering the text. If the mail reader on the receiving side doesn't handle HTML formatting, the receiver will get a plain-text representation of the message, without annoying HTML tags embedded inside.

The big news in newsreaders is better offline support. Both Navigator and IE allow download a group of news messages for later offline reading. More importantly, both can let post replies offline, which can be sent the next time when connect to the Internet. It is easier in Internet Explorer to download a newsgroup, but Netscape's three-pane newsreader makes it easier to browse and manage the newsgroups.

- **Look and Feel**

IE 3.0 lets users add their favorite links as buttons, and even add an icon to the toolbar that automatically copies the current page into users favorite HTML editor.
IE scrolls pages better than Navigator—IE smoothly slides Web pages up and down, instead of simply redrawing the pages as most applications do. And the icons go from gray to colored when the mouse moves over them, which provides great feedback.

Consistency is the strong suit of Navigator 3.0. Whether users are in the mail program, the newsreaders, or the browser itself, menus and options remain consistent across the applications. Also, all three components (mail, news, and browser) let users view fully formatted HTML pages, something still missing in IE. Navigator lets users turn off the toolbars directly from the menus, whereas IE requires users to first open up an options dialog box and then turn off the toolbar.
IE has more modern and customizable interface, but Navigator is consistence.

- **Java and More**

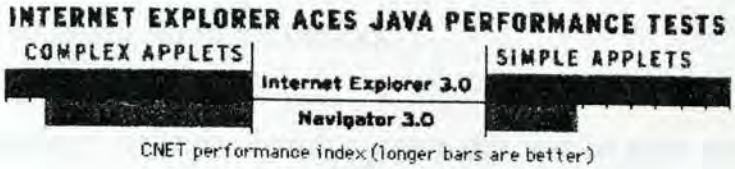
Programming browsers over the Web is the waking dream of the community of software developers: it provides easily distributed computing--the Web server just

delivers the code, and the Web client does the heavy lifting of actually executing the program. Thus, a Web site can deliver powerful content without requiring heavy-duty CPU time on the server--the clients do the work.

That's what has made Java such a success: it enables this kind of Web programming--both the language and the bytecodes (the program instructions generated by the Java compiler) are platform-independent. The same Java program can run unchanged on Unix, Windows, or Macintosh machines.

Both Navigator 3.0 and Internet Explorer 3.0 provide just-in-time (JIT) Java compilers, which turn the platform-independent Java bytecodes into machine-specific instructions. For compute-intensive operations such as mathematical calculations, this can greatly enhance the speed of the Java applet. IE 3.0 is up to 15 percent faster than Navigator for compute-intensive applets. And even on pages where a JIT compiler provides almost no benefits (simple Java applets such as animations and tickers), IE 3.0 still runs Java faster.

Figure 2.16: Java Comparison



Internet Explorer is faster on our benchmark tests than Netscape Navigator. Our testing was based on the CaffeineMark from Pendragon Systems

Naturally, Microsoft had to introduce theirs own scripting language. Luckily, instead of creating some new language, they based this new scripting language on their popular Visual Basic language. Called VBScript, it allows much of the same programmability as JavaScript but leverages the large community of developers familiar with the various Visual Basic incarnations.

Both JScript and VBScript are essentially plug-in scripting languages--they interact with Internet Explorer's underlying ActiveX scripting architecture to drive the Web browser

Internet Explorer runs Java better, and broader scripting support helps Web developers as well. But Microsoft's uneven JavaScript implementation is vexing.

- **Intranet**

The Internet Explorer 3.0 Web client has a number of advantages for companies that use the Windows 95 and Windows NT platforms. For one thing it's free, while shipping versions of Navigator aren't. The administration kit, which lets the IS department configure virtually every feature of the browser, is also free for IE, but the similar kit from Netscape costs nearly $2,000.

More importantly, IE allows users to create Intranets with hooks into their desktop business applications. For example, when a user clicks on a link to a Word document, IE will open Word inside the browser window. It's an example of in-place activation, and it's a powerful technology. Add to that the dynamic nature of ActiveX controls, and users Intranet becomes the medium for automatically keeping components consistent and up-to-date across the network.

Netscape Navigator 3.0 simply doesn't support this sort of tight operating system integration, although users can get part of the way there with specific file-viewer plug-ins as well as with Ncompass's ActiveX plug-in. But the ability to merge Web browsing and application functions is missing. Better OS integration is due in Navigator 4.0, we are told.

Integration of users desktop apps with the Intranet isn't quite seamless yet, but it is much better in IE than it is in Navigator.

- **HTML**

HTML is the basic page description language for the Internet. HTML should render essentially the same way from one browser to the next. Unfortunately, both Netscape and Microsoft have in the past pushed their own proprietary extensions to the HTML spec. This has made for tough choices for Web designers to support one browser's set of tags, and users page might be unreadable in the other browser.

In their latest browsers, Navigator and Internet Explorer continue pushing HTML. Internet Explorer 3.0 supports a few new tags, such as ones that let designers create floating and borderless frames. Version 3.0 of Navigator has a few new tags, too, such as Spacer, which allows designers to specify exact horizontal and vertical spaces

- **GroupWare**

Currently, the only collaboration tools that ships with the two browsers are essentially Web phones: Netscape's CoolTalk and Microsoft's NetMeeting. Both let users use the Internet as a telephone, as long as the contact person has the same software. The recently ratified H.323 standard, which both companies have committed to support, will eventually allow Web phones from different companies to inter-operate.
Both products support chat, where users can write text messages to each other in real time. And both support a whiteboard feature where users can collaborate and brainstorm.

However, Microsoft NetMeeting takes the next logical step by letting user share entire Windows applications via the whiteboard; multiple users can watch someone editing a Word document or a spreadsheet. And NetMeeting allows each user in a conference to take over the shared application and add their contribution. It's a neat collaboration tool, and since it involves sharing just the user interface of an application, it doesn't require that all the users install the application being shared. Of course, features such as application sharing work best over fast Internet connections. Powerful application sharing makes NetMeeting a superior groupware tool.

- **Extensibility**

Netscape's plug-in architecture was one of the crowning achievements of Navigator 2.0. It allowed developers to extend the file and media types that Navigator could handle, bringing streaming audio, VRML, and a host of other capabilities to the Web. Several of the most popular plug-ins, including QuickTime and Live3D VRML, now come bundled with Navigator 3.0.

ActiveX controls are Microsoft's answer to plug-ins. The main thing going for ActiveX controls is that they are based on Microsoft's mature Object Linking and Embedding (OLE) technology, which means there is a wide variety of Windows programming tools that already, or will soon, support ActiveX development. The other key feature is that ActiveX controls will work in any Windows program that supports the ActiveX architecture. Thus, users can install one ActiveX control that would provide similar functionality in their Web browser, their word processor, or their graphics editor.

From the user's point of view, the most compelling feature of ActiveX controls is that they can be downloaded and installed automatically. In contrast, a Netscape plug-in has to be downloaded and the browser shut down before the plug-in can be installed. Furthermore, while adding ActiveX capability, Microsoft has not forgotten the installed plug-in base. Most existing plug-ins work just fine in IE 3.0. If user install a plug-in for Navigator, IE will detect and use the plug-in as if that plug-in had been installed in IE. However, Microsoft does not support Netscape's LiveConnect architecture, so any LiveConnect plug-in will not work in IE.

This blade cuts two ways: Navigator users can also use ActiveX controls via a free Ncompass plug-in. Navigator's ActiveX compatibility is not quite as good as Microsoft's plug-in support, but it does demonstrate that ActiveX controls can run in Navigator.

Both products have great support for browser extensions: Navigator through plug-ins and IE through ActiveX. Both also offer partial support for competing extension architectures.

2.7 PROGRAMMING TOOLS

2.7.1 CGI AND PERL

CGI stands for common gateway interface and it refers to an HTML standard for defining forms and sending and receiving form data. Perl, which is Practical Extraction and Report Language, is an programming language invented by Larry Wall to create application programs that runs on networks servers. It is used not only because it is an effective programming language but also because it is free and portable for UNIX, Windows NT and Macintosh operating systems. Libraries are also available for processing ODBC from Perl [Kronenke, M, 1998].

Any programming language can use CGI. The server programs can be written in Visual Basic, C++ and Java. It is simple to learn and use and standardize. CGI is essential for processing forms, looking up records in database and generating dynamic HTML documents. Without CGI, a Web Server can offer only static documents and links to other pages or servers.

2.7.2 VBSCRIPT, JSCRIPT AND JAVASCRIPT

VBSCRIPT and JAVASCRIPT or JSCRIPT are two lightweight programming languages that can used to place programming logic into HTML pages. Both are interpreted and both are reside with the page. Using script, web page developers can control or script both ActiveX controls and generic JAVA applets. Script compatible browser is an essential need to request a scripting file from web servers. The ActiveX-scripting interface let user plug in other scripting engines.

2.7.3 JAVA

Java Applet

Java is a programming languages by Sun Microsystems. Java is important to the Internet because of its applets and applications [Naughton, P, 1997]. Java applet is an application design to be transmitted over the Internet and executed by a Java – compatible web browser. It is actually a tiny Java program and intelligent program, which can dynamically change. Java is safe for its security. Java provides firewall between a networked application and users computer by avoiding users from download viruses and malicious program which can gather private information such as credit card numbers, bank account balances and passwords by searching the contents of user computer local file system. Java is portability for all various types of platform. Java is simpler for professional programmer to use effectively since it is object oriented.

Java Beans

Java Beans is announced recently to act as JAVA answers to model component software. It allows reuse Java components and thus quickly add more functionality to existing application. Java Beans like an object oriented programming worlds, consists of two parts, data and method. The data part defines the state of the Beans. The method part defines how the state can be modified to suit programmers needs [Thomas, W, 1997].

A Java Beans application is simple and compact, is portable, fully complements Java, support flexible design-time components and support distributed computing. Java generates extremely small executables, so developers programs download quickly over a slow connection. Java lets user run the same executable in any operating system that support Java without recompiling.

2.7.4 ACTIVE SERVER PAGE (ASP)

Microsoft® Active Server Pages (ASP) is a server-side scripting technology that can be used to create dynamic and interactive Web applications. An ASP page is an HTML page that contains server-side scripts that are processed by the Web server before being sent to the user's browser. ASP can be combine with Extensible Markup Language (XML), Component Object Model (COM), and Hypertext Markup Language (HTML) to create powerful interactive Web sites.

Server-side scripts run when a browser requests an .asp file from the Web server. ASP is called by the Web server, which processes the requested file from top to bottom and executes any script commands. It then formats a standard Web page and sends it to the browser. It is possible to extend ASP scripts using COM components and XML. COM extends ASP scripting capabilities by providing a compact, reusable, and secure means of gaining access to information. ASP can call components from any script or programming language that supports Automation. XML is a meta-markup language that provides a format to describe structured data by using a set of tags.

Here are some related facts:

- ASP is free for Windows NT, or Windows95/98 – Internet Information Server 3.0 had the first ASP with all it's essential features. IIS4 (also called NT OPTION PACK 4) contains the latest ASP and all its goodies.
- ASP scripts can be tested offline with Personal Web Server (PWS) on Windows95/98 – Ironically, the CD or Download named NT OPTION PACK 4 contains the ASP enabled PWS for Win 95/98.
- ASP code is mixed within HTML on a page – it does not need to be compiled separately or deployed. HTML coders can just add ASP commands to their page freely.
- ASP scripts are pure ASCII and can be edited with Notepad or more sophisticated tools like Visual InterDev.
- ASP code is not biased towards any browser – it runs on the server and can serve up pure HTML to any browser even one that supports no scripting.

- ASP can allow browser users to manipulate databases (view, edit, manage) from any browser by serving up HTML with ADO (active data objects) and allowing HTML web pages to generate database updates which the server takes care of. Server databases can be from any vendor as long as an OLEDB or ODBC driver is available.
- ASP supports server components built with other languages. People familiar with Java, C++, Visual Basic and Delphi can assemble their compiled code easily into a component that HTML programmers can call within their ASP page.
- ASP has many 3rd party components (both free and commercial) which can acquire for FREE to reduce the programming time.
- ASP supports VBScript syntax or Jscript syntax upon initial installation. VBscript is the most popular way most users code because it is simpler than Jscript. Other languages like Perlscript can be added to ASP for free.
- ASP supports distributed and transactional architectures by coding with Microsoft Transaction Server (MTX) and Microsoft Message Que (MMQ) that are part of an ASP installation at no additional cost.

In conclusion, ASP has a lot of benefits especially in web base application. It does not only support all types of programming languages but it is compatible with HTML script. Besides, it also can be supported by all common servers and machine. For instance, instant ASP runs on Linux, Novell, Sun, Macintosh, HP-UX, SGI, SCO,Dec Alpha, IBM OS/2, RS/6000, AS/400, S/390, and Windows. It also supports Apache, FastTrack/Enterprise servers, Sun WebServer, Java WebServer, IIS, WebSphere and Lotus Domino.

2.7.5 ACTIVE X

Active X is architecture of programs elements promulgated by Microsoft. It is an architecture that can be implemented with any number different languages [Kronenke, D, 1998]. For example, it can be write in JAVA, C++, or Visual Basic. The goal of all these technologies is to enable programs to interact with another in a dynamic fashion. They do

it by using an interface called Iunknown. Query Interface can determine what objects, method and properties a program support.

2.7.6 COLD FUSION

Creating Web applications is a cinch for developers of all levels with the latest version of Allaire's development environment.

You don't need to be a hard-core developer to be an effective one, with ColdFusion 4.0 (ColdFusion Professional Server or Enterprise Server and ColdFusion Studio). It's a complete development and deployment environment ideally suited for building today's Web-based e-commerce, content management, and business-automation initiatives.

ColdFusion uses ColdFusion Markup Language (CFML), a set of special tags that are typically placed inside HTML pages and interpreted by ColdFusion Server. The tags perform such tasks as database connectivity and conditional logic, but they also handle other needs of the Web developer. For example, the tags integrate with commonly required services such as SMTP e-mail, LDAP directory service, and HTTP and FTP.

ColdFusion is an ideal choice for workgroup, departmental, and extranet applications in which fast deployment times are critical, often with the work done by less-experienced developers. With the new performance enhancements, such as clustering and native database drivers in ColdFusion Enterprise Server, ColdFusion 4.0 might be right for high-use Internet applications as well.

Developing Web Applications ColdFusion takes a Web-centric approach to creating applications, by using pages to store presentation, business, and database connectivity logic. Applications consist of a set of pages containing both HTML and CFML tags, with the HTML for presentation and the CFML tags doing the hard work. The applications can be deployed in either version of ColdFusion Server working with your choice of Web server and database.

A rich user interface can be fully customized to your tastes. You can choose from a full set of menu options, toolbars, and online help and documentation for all of the HTML, CFML, and database-related features and issues you'll face.

Busing color coding, automatic tag validation, and pop-up tips, ColdFusion Studio helps your productivity and eliminates mistakes. The tool speaks HTML and CFML, and it also interfaces with the databases and file systems that will be part of your application. For example, you can drag and drop a table field name from a database directly into your code, thus eliminating typos.

CFML includes over 60 tags for database connectivity, conditional logic, input and output, and integration with other Internet and file services. Over 200 additional functions handle items such as date and time, mathematical functions, and string manipulations.

For database connectivity, you embed SQL statements in your pages or use CFML shortcuts to relieve you from the rigor of using SQL statements. You can do presentation with standard HTML or CFML alternatives such as CFFORM and CFTABLE, which add functionality to HTML forms and simplify HTML tables, respectively.

2.7.7 VISUAL BASIC 6.0

Microsoft Visual Basic 6.0 (VB 6) has been incorporated with a number of new and enhanced features that make it more powerful and easier to use than previous versions. The features are shown in table below:

- **Native code compiler**

  VB 6 has the capability to compile a program to native code, much as C++. Therefore this will give a faster program. However, VB runtime library file is still needed to provide a fully functional program.

- **New Database features**

  Visual Data Manager is the new feature in VB 6. It eases the maintenance of database structure, as well as to input and edit the actual data. Additionally, the Visual Data Manager helps to create, test and save SQL statements in a program.

- **Internet Features**

  VB 6 includes ActiveX controls and Web Browser control to help Internet developer or programmer.

- **Others**

  Other features such as enhancement to Code Editor and Development Environment.

New features in Visual Basic 6.0

Productivity	Performance	Data Access	Internet
Enhanced IDE with IntelliSense and an extensive set of wizards	Native code with faster loading forms and controls	Microsoft SQL Server 7.0	Browser-based application development and Migration Wizard
Visual ActiveX Control creation	Microsoft Transaction Server	Enhanced RDO 2.0 with User Connection Designer	Visual ActiveX Control creation
IDE extensibility for smarter add-ins and customization	Application and database performance tools	Enhanced Oracle and Microsoft SQL Server drivers	Web browser, HTTP/FTP, and Winsock Internet controls
Enhanced controls and tools	Integrated DCOM support	Inline SQL Server stored procedure debugging	Setup Wizard for Internet deployment

Table 2.3: New Features in Visual Basic 6.0

2.7.8 CONCLUSION OF PROGRAMMING TOOLS

SIS will be implemented by using Active Server Pages because of the features provided and high suitability of ASP to SIS. It includes performance, security and relatively low

cost. Besides, it also well supported by many applications from Microsoft especially such as the integration with Microsoft Internet Information Server, the ODBC driver, Visual Basic, Vbscript, Jscript, ActiveX and of course Windows NT. For this reason, Vbscript is chosen as scripting language for this project. Meanwhile, Visual Basic 6.0 will be used to implement the administrator section because of its features provided such as database feature and Internet feature. It also provides an easy to use and "drag and drop" graphical user interface.

2.8 PLATFORM AND WEB SERVER

2.8.1 MICROSOFT WINDOWS NT SERVER

Microsoft Windows NT 4.0 is a mature and stable operating system. Windows NT makes good use of the storage space and processing power by providing in return a secure, robust and scalable. It provides several networking features like centralised account administration in which a domain is establishes by the installation of a primary domain controller (PDC) that master the account. Besides NT also provides Remote Access Service (RAS), the Distributed Component Object Model (DCOM) and the improvement in Domain Name Service for TCP/IP networking. NT synchronization account and security information and provides backup domain controllers. The improvement in the Point to point Tunneling Protocol (PPTP) and the Telephony API (TAPI) provide a secure communication between users.

With Microsoft's prestige and marketing muscle, NT will be installed by many organizations as their server of choice. At the moment, a large number of Windows applications are available, with an increasing number that leverage the 32-bit or multiprocessing nature of NT. Beside that, Microsoft's BackOffice suite provides good integration of many server applications, including system management and a database.

Most people still don't consider Windows NT an enterprise-strength solution, but it has many advantages:

- The cost of hardware for Windows NT is less than that for UNIX.
- Windows NT has strong support from third-party vendors.
- Windows NT is easy to administer, and it has a user-friendly graphical interface.
- NT provides strong security features. Its user/group concept is similar to that of UNIX, and the NT file systems allow file-level security

Design Objectives of Windows NT Server

- Client/Server Operating System
- Flat, 32-bit Memory Model
- Reliability Through Protected Memory Model
- Preemptive Multitasking
- Portability
- Scalability
- Personality/Compatibility
- Localization
- Security
- Fault-Tolerance

2.8.2 LINUX

Linux is a free, UNIX work-alike designed for Intel processors on PC architecture machines. Linux is not UNIX, as UNIX is a copyrighted piece of software that demands license fees when any part of its source code is used. Linux was written from scratch to avoid license fees entirely, although the operation of the Linux operating system is based entirely on UNIX and it shares UNIX's command set.

Linux supports a wide range of software, from TeX (a text formatting language) to X (a graphical user interface) to the GNU C/C++ compilers to TCP/IP networking. Linux is

also compliant with the POSIX.1 standard, so porting applications between Linux and UNIX systems is a snap.

Linux vs. UNIX

UNIX is a trademark of X/Open. Linux is not a trademark, and has no connection to the trademark UNIX or X/Open. UNIX is one of the most popular operating systems worldwide because of its large support base and distribution. It was originally developed as a multitasking system for minicomputers and mainframes in the mid-1970s, but it has since grown to become one of the most widely used operating systems anywhere, despite its sometimes confusing interface and lack of central standardization.

UNIX is a multitasking, multi-user operating system. This means that there can be many people using one computer at the same time, running many different applications. (This differs from MS-DOS, where only one person can use the system at any one time.)

Under UNIX, for users to identify themselves to the system, they must log in, which entails two steps: Entering your login name (the name by which the system identifies you), and entering your password, which is your personal secret key to logging in to your account. Because only you know your password, no one else can log in to the system under your username.

In addition, each UNIX system has a hostname assigned to it. It is this hostname that gives your machine a name, gives it character, class, and charm. The hostname is used to identify individual machines on a network, but even if your machine isn't networked, it should have a hostname.

Versions of UNIX exist for many systems, ranging from personal computers to supercomputers. Most versions of UNIX for personal computers are quite expensive and cumbersome. Where does Linux fit in? Well, Linux is free (solves the expensive part), very powerful, and easy to install and maintain by an individual (so much for the cumbersome part).

Features in Linux

Important features in Linux that is **unique** :

- Full multitasking and 32-bit support. Linux, like all other versions of UNIX, is a real multitasking system, allowing multiple users to run many programs on the same system at once. Linux is also a full 32-bit operating system, utilizing the special protected-mode features of Intel 80386 and later processors and their work-alikes.

- The X Window System. The X Window System is the de facto industry-standard graphics system for UNIX machines. A complete version of the X Window System, known as XFree86, is available for Linux. The X Window System is a very powerful graphics interface, supporting many applications.

- TCP/IP (Transmission Control Protocol/Internet Protocol) support. This is the set of protocols that links millions of university and business computers into a worldwide network known as the Internet. With an Ethernet connection, you can have access to the Internet or to a local area network from your Linux system. Using SLIP (Serial Line Internet Protocol) or PPP (Point to Point Protocol), you can access the Internet over phone lines with a modem.

- Virtual memory and shared libraries. Linux can use a portion of your hard drive as virtual memory, expanding your total amount of available RAM. Linux also implements shared libraries, allowing programs that use standard subroutines to find the code for these subroutines in the libraries at runtime. This saves a large amount of space on your system; each application doesn't store its own copy of these common routines.

- The Linux kernel uses no code from AT&T or any other proprietary source. Much of the software available for Linux is free. In fact, a large number of utilities in Linux are developed by the GNU project at the Free Software Foundation in Cambridge, Massachusetts. However, Linux enthusiasts, hackers, programmers, and recently even

commercial companies from all over the world have contributed to the growing pool of Linux software. Linux supports (almost) all of the features of commercial versions of UNIX. In fact, some of the features found in Linux may not be available on other proprietary UNIX systems.

- GNU software support. Linux supports a wide range of free software written by the GNU Project, including utilities such as the GNU C and C++ compiler, gawk, groff, and so on. Many of the essential system utilities used by Linux are GNU software.

- Linux is compatible with the IEEE POSIX.1 standard. Linux has been developed with software portability in mind, thus supporting many important features of other UNIX standards.

- Virtual memory support. Linux utilizes all of your system's memory, without memory limits or segmentation through the use of a virtual memory manager.

- Built-in support for networking, multitasking, and other features. You'll see this touted as "New Technology" in systems such as Windows NT. In fact, UNIX (and now, Linux) has implemented this "new technology" for more than 15 years.

2.8.3 COMPARISON BETWEEN WINDOWS NT AND SOLARIS

The capabilities of Windows NT Server 4.0 Web services and Solaris 2.6 with SWS differ and had a significant effect on the performance. The table below highlights the relevant features that affected this benchmark.

Table 2.4: Web Server Capabilities

Feature	Windows NT Server 4.0	Solaris 2.6 with SWS 1.0
HTTP 1.1 Support	Compliant	Partial compliance
HTTP 1.1 Persistent Connection Support	Yes	Yes (could not be used by WebBench 2.0)
Programming Interfaces	CGI, ASP (Active Server Pages), ISAPI	CGI

2.8.4 WHY CHOOSE WINDOWS NT?

1) Compatible with Microsoft and Netscape

- Microsoft Windows 95/98 is the worldwide most preferred desktop operating system and the leader in developing software. Meanwhile, Netscape specializes in innovative cutting-edge of today Internet applications.

- Most of the programming tools in today's trend are Microsoft based developed language. For instance, Visual Basic, Visual C++ and Visual J++. Moreover, some DBMS tools such as Ms InterDev and Ms SQL are gaining popularity in most corporation.

- Most of today application are Windows and DOS compatibility. Integrity of module into a system will not need any patch from different software developer. Thus, it lessens the time and cost in developing system. This is beneficial for the previous developed software in terms of investment.

- Linux or UNIX operating system do not offer much software development tools especially web-based publishing software. Lack of development tools has contributed to less efficient and slow progressing operating system. Most of the application in UNIX are developed via a command line compiler and simple text editor.

2) Cost savings

- Windows NT is a very cost-effective operating system. With the budget around RM 2000, a fully functional Internet Server is running in matter of days.

- Microsoft provide support and maintenance for the purchased software. It is advisable to utilize other Microsoft products since incentive will be given.

- Windows NT scalability where it can move to a even faster, multiprocessor PC server or a high performance RISC (Reduced Instruction Set Computer) based server, thus offer flexibility of the operating system.

- In order to make certain modification in UNIX, the whole operating system needs to be recompiled which is differ from Windows NT in major configuration only by rebooting the server. Hence, it cuts administration time and cost.

3) User friendly environment

- Interface of Windows NT 4.0 environment origin from the Windows 3.x operating system where the first and foremost *window* like interface that offer multitasking with the user friendly features.

- Differ from UNIX or Linux operating system where most of the tasks are performed by command script which is definitely very troublesome. Furthermore the user interface is too cryptic is not user friendly at all and a great deal of time may be wasted by learning some command task.

- Besides cryptic user interface, UNIX application demands steep learning curve where it is very difficult for new user. Thus, it is time consuming and waste lots of learning time and cost.

- Complicated installation procedure. Each UNIX machine has their different documented installation procedure. Prior to installation, the source code (Kernel) need to be compiled.

4) Security

- The distribution of Linux and UNIX source code is widely available in the Internet. Besides the administrator benefited from the source code, the potential hacker has the possible vulnerability point of attack.

- However, this differ from Windows NT where most of the application are not freely available in the Internet. Besides, Windows NT operating system utilize binary codes, thus result complicated vulnerability point of security. As a result, this can seriously compromise the security of many servers at a time where they use the same code.

2.8.5 REVIEW OF WEB SERVER SOFTWARE

Personal Web Server

Microsoft Personal Web Server is a desktop Web server for Windows NT Workstation, Macintosh, Windows 98 and Windows 95 client computer. It enables developers to publish their personal home page, share documents with certain workgroup or build Web applications for Windows NT Server's built-in Web server, Internet Information Server (IIS). Owner of the Web server can use the site administrator tools to read messages, browse and retrieve files from user's disk. Microsoft Personal Web Server will automatically convert SimpleText documents.

Advantages

- **Provide a good test drive for IIS Web site**

  Personal Web Server on Microsoft Windows NT Workstation is also ideal for developing Web applications for IIS. PWS on Windows NT Workstation includes support for features such as Active Server Pages, script debugging , and the Internet Service Manager, the comprehensive administration tool for IIS integrated into Microsoft Management Console. Transactional Web applications for Microsoft Transaction Server (MTS), also part of Windows NT Server can be developed. Personal Web Server is a great platform for testing before hosting the site on the company server, or on an Internet service provider. Links, forms, scripts, and

applications can be checked to be sure they are displaying and functioning correctly. Microsoft FrontPage also can be used to easily copy a Web site developed on PWS to IIS.

- **Provide wizards**

  Personal Web Server (PWS) includes a wizard that walks developer through setting up a home page and sharing files. The Personal Web Server administrator also reduces the complexity of running a Web server. Personal Web Manager enables the developer to start and stop the server, view statistics, and easily share additional directories or the Windows Explorer.

Disadvantages

- **Do not support high volume Web sites**

  Because Personal Web Server was not designed to support high volume Web sites, it does not include all the features found in Internet Information Server, such as Microsoft Site Server Express, Index Server, and Certificate Server.

Apache 1.3

Apache 1.3 is UNIX web server and available free of charge. It also can run in Windows NT. Apache can obtain from the internet and all the core and module source code can be get and modified to suit developers' needs. Hosting multiple IP addresses on an Apache server is done with little configuration.

Netscape Enterprise Server (NES)

It is produced by Netscape Web Server. It supports Oracle, Informix, Java, LDAP and use to convert pdf file to HTML. NES can run either in UNIX or Windows NT Server. It has a direct link to a DBMS and automatic directory tree.

Microsoft Internet Information Server 4.0 (IIS 4.0)

Microsoft Internet Information Server (IIS) is built into the Microsoft Windows NT Server operating system. It was designed to deliver a wide range of Intranets and the Internet server capabilities for corporate. IIS can be used alone as a Web server, or in conjunction with compatible technologies to set up Internet commerce, to access and manipulate data from a variety of data sources, and to build Web applications that take advantage of server script and component code to deliver client-server functionality.

Advantages

- **Enable to generate dynamic Web pages with HTML templates**
  IIS 4.0 enables creating HTML page templates with Active Server Pages to build pages dynamically and make sites easier to keep up-to-date.

- **Provide an easy information searching on the Web**
  IIS 4.0 introduces updated indexing and searching functionality to the built-in content indexing and search engine for IIS. This allows users to search for content on the server using a standard Web browser.

- **Provide the facilities to capture specific user information**
  IIS 4.0 provides three new logging features that enable information retrieve from the IIS 4.0 Web site to be customized easily. The features are as follow.
  - **Specify log file information**
    With IIS 4.0, detailed information about the site visitors such as date, time, client IP address, and browser type can be gathered, while minimizing log file size by omitting unneeded fields.
  - **Track specific files**
    IIS 4.0 also enables certain files to be chosen to collect data, thus improving performance, reducing log file size, and making it easier to interpret the log files.
  - **Customize logs on your site**
    IIS 4.0 allows developers to create custom components for processing specific

user activities and writing to a SQL Server data source or a custom log file format.

- **Enable to analyze server log files and site content**

  Microsoft Site Server Express - Analysis makes it easy to analyze the server log files and site content. The Site Server Express feature set provides basic functionality to that found in Microsoft Site Server. In order to analysis log files, Site Server Express - Analysis provides an easy way to identify basic trend and usage information from an IIS 4.0 log file in order to make more informed business decisions. The Usage Import and Report Writer modules of Site Server Express - Analysis enable to:

  - Import an IIS log file and translate *hits* into useful information.
  - Easily organize that information to over 20 pre-defined reports using HTML or popular business software formats
  - Automate the import and analysis of log files through an easy to use scheduler.

  For the content quality maintenance, Microsoft Site Server Express - Analysis also monitors site quality and provides feedback to site administrators and content developers that will help them improve the usability of their sites. The Content Analyzer module of Site Server Express - Analysis lets a site administrator easily visualize how a site is layed out and report on the content types composing the site. With IIS 4.0 and Site Server Express enable problems to be easily identified.

- **Improving the user experience**

  IIS 4.0 makes it easy to customize how content is presented on the site.

- **Enable to custom error messages**

  IIS 4.0 allows developers to customize the content that is returned to a browser or run an application to handle the error. Instead of using the default error messages, administrators can choose to send custom error messages to the client. These

customizable error messages can be in the form of a file or a URL. Developers can define custom ASP pages to handle specific errors.

- **Tightly integrated with Windows NT Server**

  IIS provides high performance on Windows NT Server and delivers superior price performance to comparable UNIX-based systems. IIS also brings the security of Windows NT Server to the Web site, without additional configuration, to protect information with the ease of a single user directory and the ability to log on to a network. Windows NT Server with IIS also provides an integrated set of tools for running and managing all of your network, Web, and application services reducing training time for administrators.

2.8.6 COMPARISON BETWEEN IIS WITH OTHER WEB SERVER

The Table 2.5 below compares Internet Information Server (IIS) 4.0 with other web server on the market.

FEATURE	*IIS 4.0*	NETSCAPE ENTERPRISE SERVER 3.01	APACHE 1.2
Internet services			
HTTP 1.1 compliant	*Yes*	Yes	Yes
Access HTTP Host Headers sites using any browser	*Yes*	No	No
Integrated SMTP support	*Yes*	Requires add-on	No
Integrated NNTP support	*Yes*	Requires add-on	No
Setup and Administration			
Setup Wizard	*Yes*	No	No
Unattended Setup	*Yes*	No	No
Integrated management console administration	*Yes*	No	No
Task-based administration	*Yes*	No	No
Delegation of administration tasks	*Yes*	Yes	No
Administer a server from any Web browser	*Yes*	No	No
Administer multiple Web servers from any browser	*Yes*	No	No
Monitor multiple host machines simultaneously	*Yes*	Yes	No
Manage multiple Web servers as one server	*Yes*	Yes	Yes
Command-line administration	*Yes*	Yes	Yes
Scriptable administration	*Yes*	Yes	Yes
Configuration backup and restore	*Yes*	Yes	No
Separate Web site administrators	*Yes*	Yes	No
Per-Web site applications	*Yes*	No	No
Limit network bandwidth used	*Yes*	No	No
Limit network bandwidth by Web site	*Yes*	No	No
Multiple hardware virtual servers through separate IP address	*Yes*	Yes	Yes

Multiple software virtual servers through host headers	*Yes*	Yes	Yes
Integrated directory	*Yes*	Requires add-on	No
SNMP support	*Yes*	Yes	No
Windows NT Server performance monitor integration	*Yes*	Yes	No
Monitor individual Web site performance	*Yes*	No	No
Logging			
Log to any ODBC database	*Yes*	No	Requires add on
Log multiple servers to a single ODBC database	*Yes*	No	No
W3C extended log format	*Yes*	No	Yes
Log with common log format	*Yes*	Yes	Yes
Log to text file	*Yes*	Yes	Yes
Writes file security events to the Windows NT Server Event Log	*Yes*	No	No
Writes application events to the Windows NT Server Event Log	*Yes*	Yes	No
Custom logging	*Yes*	Yes	Yes
Built-in log file analysis	*Yes*	Yes	No
Auto log closing and start new log based on time interval	*Yes*	No	Yes
Auto log closing and start new log based on log size	*Yes*	Yes	No
Log to event log or system log	*Yes*	Yes	No
Developing and Deploying Web-Based Applications			
Application and component process isolation	*Yes*	No	Yes
Built-in support for transactions	*Yes*	No	No
Integrated support for application message queuing	*Yes*	No	No
Automatic database connection pooling	*Yes*	No	No
Language-neutral server-side development	*Yes*	No	No
Supports any ActiveX scripting language (Visual Basic® Scripting Edition and JScript)	*Yes*	No	No
Server-side scripting debugger	*Yes*	Yes	No
Compile-free server-side scripting	*Yes*	No	Requires add-on
Cross-platform ODBC database connector	*Yes*	Yes	No
Component load/unload without stopping the server	*Yes*	No	No
Programmable logging interface	*Yes*	No	Yes
Java virtual machine for the server	*Yes*	Yes	No
Support for DCOM	*Yes*	No	No
CORBA/IIOP support	*Third-party*	Yes	No
ISAPI support	*Yes*	No	No
NSAPI support	*No*	Yes	No
Authentication and Security			
Integrated certificate server	*Yes*	No	No
Windows NT Server security integration	*Yes*	No	No
Windows NT Server authentication through X.509 certificate	*Yes*	No	No
Secure Windows NT Server user authentication with encrypted passwords	*Yes*	No	No
Uses Windows NT Server security ACLs	*Yes*	No	No
Restrict access by IP address	*Yes*	Yes	Yes
Restrict access by directory and file	*Yes*	Yes	Yes
Restrict access by domain name	*Yes*	Yes	Yes
Restrict access by user and group	*Yes*	Yes	Yes
Domain blocking by IP address and host name	*Yes*	Yes	Yes
SSL 2.0 support	*Yes*	Yes	No
SSL 3.0 support	*Yes*	Yes	No
Server gated crypto	*Yes*	No	No
Secure administration	*Yes*	Yes	No
Basic HTTP user authorization with clear-text passwords	*Yes*	Yes	Yes

ACLs. Permissions synchronized with directory	*Yes*	No	No
Content Management			
Data replication	*Yes*	No	No
Custom HTTP headers	*Yes*	No	Yes
HTTP redirect	*Yes*	Yes	Yes
Content ratings	*Yes*	No	No
Content expiration	*Yes*	No	Yes
Document footers	*Yes*	Yes	Yes
Custom error messages	*Yes*	Yes	Yes
Flexible file management	*Yes*	No	No
Store and serve content from multiple platforms	*Yes*	Yes	Yes
One-button publishing	*Yes*	Yes	No
Graphical HTML Web page editing	*Yes*	No	No
Graphical site map	*Yes*	No	No
Graphical server key management	*Yes*	No	No
Graphical file and directory management	*Yes*	Yes	No
Automatic link validation	*Yes*	Yes	No
Automatic link recalculation	*Yes*	Yes	No
HTML page and site wizards and templates	*Yes*	No	No
Built-in image map handling	*Yes*	Yes	Yes
Image and document conversion support	*Yes*	No	No
Query file index using SQL	*Yes*	No	No
Integrated with Windows NT Server file security	*Yes*	No	No
Scriptable	*Yes*	No	No
Programmable	*Yes*	No	No
Integrated administration	*Yes*	Yes	No
Automatic ally updates index when a change is made	*Yes*	Yes	No
Foreign-language support	*Yes*	No	No
Index document properties	*Yes*	Yes	No
Linguistic analysis (stemming, inflection)	*Yes*	Yes	No
Supported multiple document formats	*Yes*	Yes	No
Query HTML document property meta tags	*Yes*	Yes	No
Limit queries by directory	*Yes*	No	No
Query and search with client-side ActiveX Control (ADC)	*Yes*	No	No
Hit-highlighting	*Yes*	Yes	No
Return document properties in query results	*Yes*	No	No
Text operators	*Yes*	Yes	No
Property operators	*Yes*	Yes	No
Custom views	*Yes*	Yes	No
Documentation			
Online documentation	*Yes*	Yes	Yes
Multimedia documentation	*Yes*	No	No
One-step printing	*Yes*	No	No
Full-text search	*Yes*	No	No
Service and Support			
Worldwide educational centers	*Yes*	No	No
Quick Fix Engineering	*Yes*	No	No
Enterprise 7x24 support	*Yes*	No	No
Training courses	*Yes*	Yes	No
Developers network	*Yes*	Yes	No
Trained and certified network of solution providers	*Yes*	Yes	No
Priority 7x24 technical support	*Yes*	Yes	No
Incorporated consulting services division	*Yes*	Yes	No
Online support	*Yes*	Yes	Yes

2.8.7 CONCLUSION OF PLATFORM AND WEB SERVER SOFTWARE

Student Information System will use Windows NT as the platform and since IIS 4.0 is free together with Windows NT, it is the best web server to choose. Not only that, NT and IIS is integrated together to give a high performance, security and feasibility Student Information System environment.

2.9 DATABASE

2.9.1 INTRODUCTION

Database is a shared collection of logically related data, designed to meet the information needs of an organization.

2.9.2 EVOLUTION OF DATABASE AND COMPARISON OF DATABASES

Database has undergone four major phases of changes.

The first phase comes to indexed file system approach. Index File-based system is a collection of application that perform services for the end-users such as the production of reports. Data is stored in the form of indexed files and there is no centralized control of data. Each program defines and manages its own data.
However there are limitation in this approach. The major limitations include separation and isolation of data, duplication of data, data independence, incompatible file formats and fixed queries or proliferation of application programs.

Hierarchical and Networked Database System are the second phase on database evaluation. The second approach system data structure is in ordered set of free. It supports multi-user and overcome the indexed file system. The network and hierarchical systems adopt a navigation approach, which means that they specify how, the data is to

be retrieved. Since the main problems are they provide a substantial amount of data dependence and tedious navigation in accessing database.
Meanwhile, the third phase which is relational database systems adopt a declarative approach to database processing that is, they specify what data is to be reprieved. This overcome the second approaches limitation and provide a huge amount of data dependence. Relational database is the majority of modern commercial system that supports well for client server applications. For example SQL Server 7.0 is a well database manager. The success of relational is evident.

There are weakness of relational database management when the particular database requirements for the new of advanced applications that are becoming increasingly common place. These system are Computer-Aided Design, Computer-Aided Manufacturing, Computer-Aided Software Engineering, Office Automation, Computer-Aided Publishing, others multimedia systems and else with complex and interrelated objects and procedural data. All of the is because of the conventional database hardly supporting non-atomic and abstract types of data. Besides relational database does not representation of real world entities, semantic overloading, some integrity and enterprise constraints and homogenous data.

The fourth phase is extended relational and object-oriented database system. This new style has demonstrated such significant advantages over traditional programming that almost all new development at software vendors is done in object oriented programming.

The advantages of it is the integrated with programming language, automatic method storage when available, user defined types, complex data readily processed, automatic persistent objects Ids and single level memory. Even though it overcomes the traditional database, its lack is OODB require object-oriented programming. Little existing data in object form, non-existent in poor query and reporting tools, limited concurrency control and transaction management, unproven performance, substantial changes and learning required.

2.9.3 REVIEW OF OBJECT ORIENTED DATABASE

Object oriented database technology is a marriage of Object Oriented Programming and Database Technology. Object-oriented database includes the object-oriented concepts from the three categories:

Object-Oriented Programming Language

OOP consists of objects, class, instance, method, encapsulation, inheritance and polymorphism. Object is a unique identifiable entity that contains both attributes and describes the state of a real world object and its action. Class is a collection of attribute definition meanwhile instance represent the individual real world objects represented in the database. Method is referred to the behaviour of an object. The term Encapsulation is the process of combining data and function of an object and it draws a capsule around related things and hides the implementation details. It provides data independence. Inheritance is the mechanism for creating a new class definition and used for reuse. Polymorphism is simply means the same method can do different things depending on the class that implements it.

Data modeling

In data modeling, entity represents the real world object, attribute is the property of object, relationship is referred to the association among objects such as "has a" and "is a" and aggregation describes the relationship between objects in which an objects contains references to one or more objects.

Database system

In database system, there are four issues needs to be understood. Firstly "transaction". Transaction is a logical network that should always transform the database from one consistent state to another. Secondly, data integrity is for the prevention of data modification. Thirdly, concurrency control is the control on data when there are multi users accessing the same data. Version management is the process of maintaining the evolution of objects.

2.9.4 MICROSOFT SQL SERVER 7.0

History of SQL Server

IBM invented a computer language back in the 1970s designed specifically for database queries called SEQUEL; those letters stand for Structured English Query Language. Over time, the language has been added to so that it is not just a language for queries, but can also build databases and manage the database engine's security. IBM released SEQUEL into the public domain, where it became known as SQL. Because of this heritage you can pronounce it "sequel" or spell it out "S-Q-L." There are various versions of SQL used in today's database engines. Microsoft SQL Server uses a version called Transact-SQL, or T-SQL, which stands for Transaction SQL.

Microsoft initially coded a SQL server (a database product that understands the SQL language) with Sybase Corporation for OS/2. When Microsoft abandoned OS/2 in favor of its new network operating system, Windows NT Server, it decided to do the SQL server engine for Windows NT by itself. The resulting product was Microsoft SQL Server 4.2, which was updated to 4.21. After Microsoft and Sybase parted ways, Sybase further developed its database engine to run on NT (Sybase version 10 and now Version 11), and Microsoft developed SQL Server 6.0 (now 6.5), which also runs on top of Windows NT.

SQL Server and Client/Server Model

Microsoft's SQL Server is a client/server database engine, client/server model is important. Client/server can be defined as an application that is split into two parts: One part runs on a server, and the other part runs on workstations. The server side of the application provides security, fault-tolerance, performance, concurrency, and reliable backups. The client side provides the user interface and can contain empty reports, queries, and forms. The idea is to have the best of both worlds by taking the advantages of both and pairing them.

Advantages to:

Client	Server
Easy to use	Reliability
Support on multiple hardware platforms	Concurrency
Support on multiple software applications	Sophisticated locking
Familiar to the user	Fault-tolerance
	High performance hardware
	Centralized control

Table 2.6: The Advantages to Client and Server

Security Option

SQL Server has three different security options to choose from. The options are Integrated, Standard, and Mixed. Based on your enterprise environment, you need to choose the appropriate security option. To determine which security option is right for your enterprise, you need to ask the question, "Where does SQL Server get information about user accounts?" There are three answers: from the Windows NT SAM database, from SQL Server's own internal database, or from both.

In an integrated security environment, SQL Server uses Windows NT's SAM (Security Accounts Manager) database for validation of SQL Server logins. This means that user accounts must be accessible to SQL Server. To implement this, you must be using either the named-pipes or multiprotocol network protocols. SQL Server will also need access to the Windows NT SAM database, either locally or through a trust relationship. This type of security simplifies access for users because they only need to log on to Windows NT in order to gain access to the SQL Server.

In a standard security environment, SQL Server will use its own database table (syslogins) to verify logins. There are no special network protocols needed for users to access the SQL Server, just the appropriate SQL Server login ID and password. This type of security can be useful in an environment where SQL Server does not have access to a Windows NT SAM database, or where users are getting their login credentials from a different security provider, such as Novell NetWare. In a mixed security environment, SQL Server will first check for a mapped login ID from the NT SAM database; if it finds

one, you will be logged in with that ID. If there is no match, SQL Server will validate the login ID and password that you specify. This type of security is helpful in environments where there are several different security providers.

The following features support the latest Microsoft SQL Server 7.0 version:

- **On-demand memory**

Provide a key administrative advantage over previous versions, the dynamic memory management features tune the server and offer the best possible performance based on available memory and other application demands.

- **On-demand disk space allocation**

With dynamic memory management, the new space allocation strategy offers the administrator more control and at the same time more automated response to the daily management of the server. As the database grows, SQL server will allocate a percentage of new disk space. Theses option are implemented to address the previous need to manually build new devices and extend databases to the new devices.

- **Recursive triggers**

Manage more than one update to a given column. Recursive triggers will in turns will fire another trigger when first make update trigger.

- **Full row-level locking**

It is possible to lock escalation procedure within the server engine since the inception of SQL Server.

- **New security that support NT groups and SQL server roles**

User roles allows to define groups and security associated with them. This features permits for managing more closely to user rights and it broadens the capabilities of the security system by adding new security permissions and methods of applying.

- **Unicode support**

It is the industry standard manner in representing information for database. With this Unicode support , new and different data types sizing restrictions.

- **ADO, ODBC, OLE DB AND SQL-DMO programming interfaces**

These tools are supported and continue to hold open the door for the multiple third-party tools to manage and work with databases.

- **Enhanced Query Analyzer and optimizer**

A replacement to ISQL/W. This new query adds more color-coded queries and more analysis tools.

- **Wizards**

A wizard-type interfaces is automating many functions required for DBA. The wizards are seen as a mean to ease the work load of running some critical SQL Servers.

- **Data Transformation Services**

Provide a level of functionality and leverage OLE DB. It allows to extract data from multiple data sources, scrub it and perform operations on the data as it is moved from its source into SQL Server 7.0.

- **Microsoft English Query**

Able to query a known database with English-like sentences and questions. After database table structure has been defined, this tool is able to ask questions and have them translated into appropriate SQL.

- **OLAP**

Online Analytical Processing (OLAP) has been relegated to third party in extracting data, package it and analyze it. It paves a way for widespread use for this very powerful analysis technique.

- **Windows 9x support**

With the introduction of Windows 9x, Microsoft SQL Server 7.0 can be run on laptop or desktop system. The desktop implementation is identical to server version. It directly impact the operating system capabilities.

- **Microsoft Management Console (MMC)**

MMC is a replacement for Enterprise Manager. MMC gives the administrator the access need to the server. The MMC is also a standard interface for all Microsoft server applications. Meanwhile, Enterprise Manager become the snap-in to the MMC, which allow to administer NT, IIS and MTS application.

2.9.5 ORACLE DBMS

Introduction

Oracle Corporation's reputation as a database company is firmly established in its full-featured, high-performance RDBMS server. With the database as the cornerstone of its product line, Oracle has evolved into more than just a database company, complementing its RDBMS server with a rich offering of well-integrated products that are designed specifically for distributed processing and client/server applications.

As Oracle's database server has evolved to support large-scale enterprise systems for transaction processing and decision support, so too have its other products, to the extent that Oracle can provide a complete solution for client/server application development and deployment. This chapter presents an overview of client/server database systems and the Oracle product architectures that support their implementation.

Oracle 7 RDBMS Server

The Oracle7 server is a full-featured RDBMS that is ideally suited to support sophisticated client/server environments. Many features of the Oracle7 internal architecture are designed to provide high availability, maximum throughput, security, and efficient use of its host's resources. Although all these features are important architecturally for a database server, Oracle7 also contains the following language-based

features that accelerate development and improve the performance of server-side application components.

- **PL/SQL language**

A major component of the Oracle7 server is its PL/SQL (Procedural Language/ Structured Query Language) processing. PL/SQL is Oracle's fourth generation language (4GL) that incorporates structured procedural language elements with the SQL language. PL/SQL is designed specifically for client/server processing in that it enables a PL/SQL program block containing application logic as well as SQL statements to be submitted to the server with a single request. PL/SQL significantly reduce the amount of processing required by the client portion of an application and the network traffic required to execute the logic. PL/SQL is extremely flexible because the language used by client is interchangeable with that used by the server.

- **Stored procedures**

Although version 6 of Oracle supported server-based PL/SQL, Oracle7 provides the capability to store PL/SQL blocks as database objects in the form of stored procedures, functions, and database packages. Calling a stored procedure from a client application generates minimal network traffic. Stored procedures provide a convenient and effective security mechanism.

- **Database triggers**

Database triggers resemble stored procedures in that they are database-resident PL/SQL blocks; the difference between the two is that triggers are fired automatically by the RDBMS kernel in response to a commit time event (such as an insert, update, or delete operation). Database triggers greatly reduce the amount of code and processing that is necessary in the client portion of an application.

- **Declarative integrity**

Constraints are enforced by the server whenever records are inserted, updated, or deleted. In addition to using referential integrity constraints that enforce primary and foreign key

relationships, define constraints to control the value domains of individual columns within a table. Server-enforced integrity reduces some of the code required for validation by the client and also increases the robustness of the business model defined within the database. With constraints, you can often improve performance and provide the flexibility to support multiple front-end interfaces.

- **User-defined functions**

PL/SQL blocks in user-defined functions. User-defined functions are similar to stored procedures and also reduce the amount of application code in the client portion of an application. Not only these functions from PL/SQL, but it can extend the set of standard Oracle SQL functions.

2.9.6 MICROSOFT ACCESS 2000

MS Access is the relational database management system used to create the relational databases. Together with the ODBC driver for Access, data can be retrieve from the database in client/server based system. It contain facilities to import, export and links table to HTML files, to process hyperlinks into or out of database applications and to publish tables, forms and reports in HTML format. Additionally, forms and datasheets can be saved as ActiveX Server pages.

2.9.7 CONCLUSION ON DATABASE

There are two types of database that are relational database and object oriented database. Both types of database have their lacks and strengths. However, SIS will be using the relational database because:

- The lacks of reporting features in object oriented database compare to relational database

- Records of SIS are not in type of graphic and the system is not a scientific application or CAD or engineering system
- The stable and features in relational database
- The loading time is extremely faster for relational database in terms of retrieving many text-based records

Chapter 3: System Analysis

3.1 CURRENT EDUCATION SYSTEM

3.1.1 UNIVERSITY OF MALAYA EDUCATION SYSTEM

Local universities such as University of Malaya (MU), University Putra Malaysia (UPM), University Kebangsaan Malaysia (UKM) and University Sains Malaysia (USM) are still using the Semester System. Semester System has been the global education system for local universities currently. This system has been followed the model of United Kingdom where each degree program has its own duration for graduation. Semester System has been fully carried out in University of Malaya since 1996/1997.

The education system rules in local universities keep changing every year. Administrator will have to produce a general guideline book to update new rules set up by the university for the education management purpose.

University of Malaya is still using the traditional client/server application in its local LAN. This traditional application is the Student Information System (SIS). SIS is used to manage student course registration and exam registration.

Semester System state that [Buku Panduan Umum Sistem Semester, 1998]:

- Each student from UM can register for whatever semester (accept third semester) for each provided academic
- Student pay fees depends on their registered credit hours
- Students are allowed to follow courses from whatever local or foreign education institution for whatever semester
- Students can register for elective courses and credits hours obtained are depending on certain conditions or requirement

- Student are allowed to re-take the fail paper if it is offered for certain semester
- Students are given the opportunities to recover grade C- and below
- Each student is guided by their given academic adviser
- Each course has a duration of one semester to finish unless with the permission from Senat
- Course grading is depends on its objective and topics
- PGA determines each semester's result
- Overall results are through calculation on CGPA
- Co-curriculums are givens credit hours
- University courses are also offered for each semester
- Third semester enable students to graduate earlier
- Enrollment for all degree students begins at first semester
- No delay registration
- Students are not allowed to register more than one degree

3.1.2 CURRENT REGISTRATION ACTIVITIES

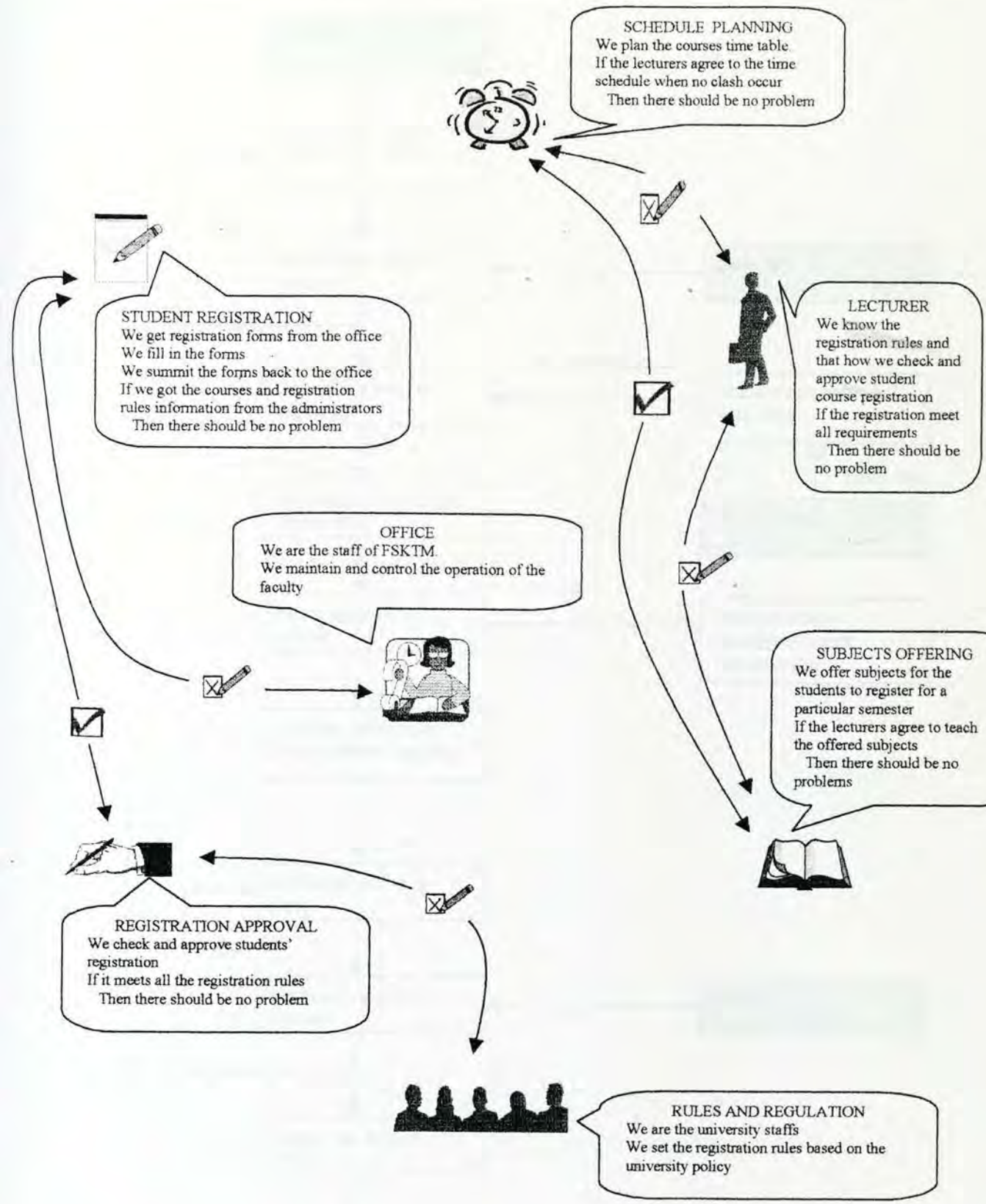
At the end of every semester, students are required to fill up a pre-registration form in order to register subjects for the next semester. This pre-registration form is called PPO1 form. Students are required to fill in their personal details and state which subjects that they are going to take for the next semester in this form. This form required the student academic advisor to approve before it is summit to the office. This process usually done before the semester break.

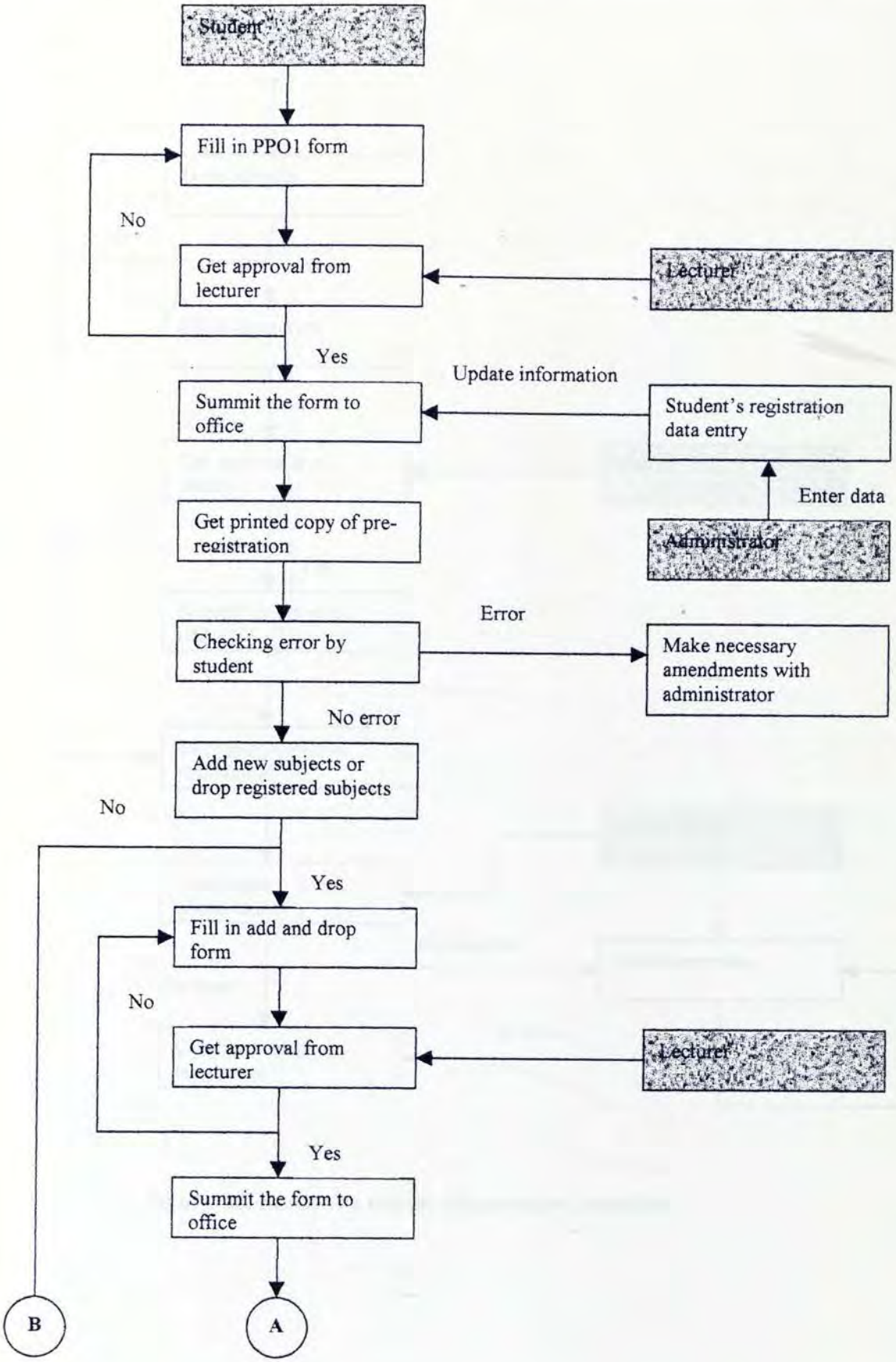
When university reopen, students will be given a printed copy of their pre-registration to confirm the registered subjects of their choice. Since this is only a pre-registration, students are allowed to make changes to the earlier registered subjects. This can be done by filling up an add and drop form. This form allowed them to register other subjects and drop some of the earlier registered subjects. This process usually done after students had

got their results. Students results usually available on the first week or second week of the new semester. These add and drop form must be completed within the first three weeks of the new semester.

However within the third and seventh week, students are still allow to drop subjects by filling another form called the drop form. But this time students have to go to the SKR to do the drop process and also have to get the Dean approval. The earlier processes can be done in their own faculty.

Upon the registration by the students, the SKR will print out a list of student registration data and distribute the list to the faculty. The administrator will check the student registration manually to locate or find any errors that might be occur. The checking is based on the registration rules and regulation set by the faculty. If any errors found on the student registration data, students will be informed by notices and they have to go to the office to make necessary amendments. The complete course registration activities are shown in Figure3.1 and Figure 3.2. Figure 3.2 show as a rich picture of the current registration activities. Soft System Methodology is using pictures or graphics to represent object in order to illustrate the problem or situation.


SCHEDULE PLANNING
We plan the courses time table.
If the lecturers agree to the time schedule when no clash occur
Then there should be no problem
STUDENT REGISTRATION
We get registration forms from the office
We fill in the forms
We summit the forms back to the office
If we got the courses and registration rules information from the administrators
Then there should be no problem
LECTURER
We know the registration rules and that how we check and approve student course registration
If the registration meet all requirements
Then there should be no problem
OFFICE
We are the staff of FSKTM.
We maintain and control the operation of the faculty
SUBJECTS OFFERING
We offer subjects for the students to register for a particular semester
If the lecturers agree to teach the offered subjects
Then there should be no problems
REGISTRATION APPROVAL
We check and approve students' registration
If it meets all the registration rules
Then there should be no problem
RULES AND REGULATION
We are the university staffs
We set the registration rules based on the university policy


Student
Fill in PPO1 form
No
Get approval from lecturer
Lecturer
Yes
Update information
Summit the form to office
Student's registration data entry
Enter data
Get printed copy of pre-registration
Administrator
Error
Checking error by student
Make necessary amendments with administrator
No error
Add new subjects or drop registered subjects
No
Yes
Fill in add and drop form
No
Get approval from lecturer
Lecturer
Yes
Summit the form to office
B
A

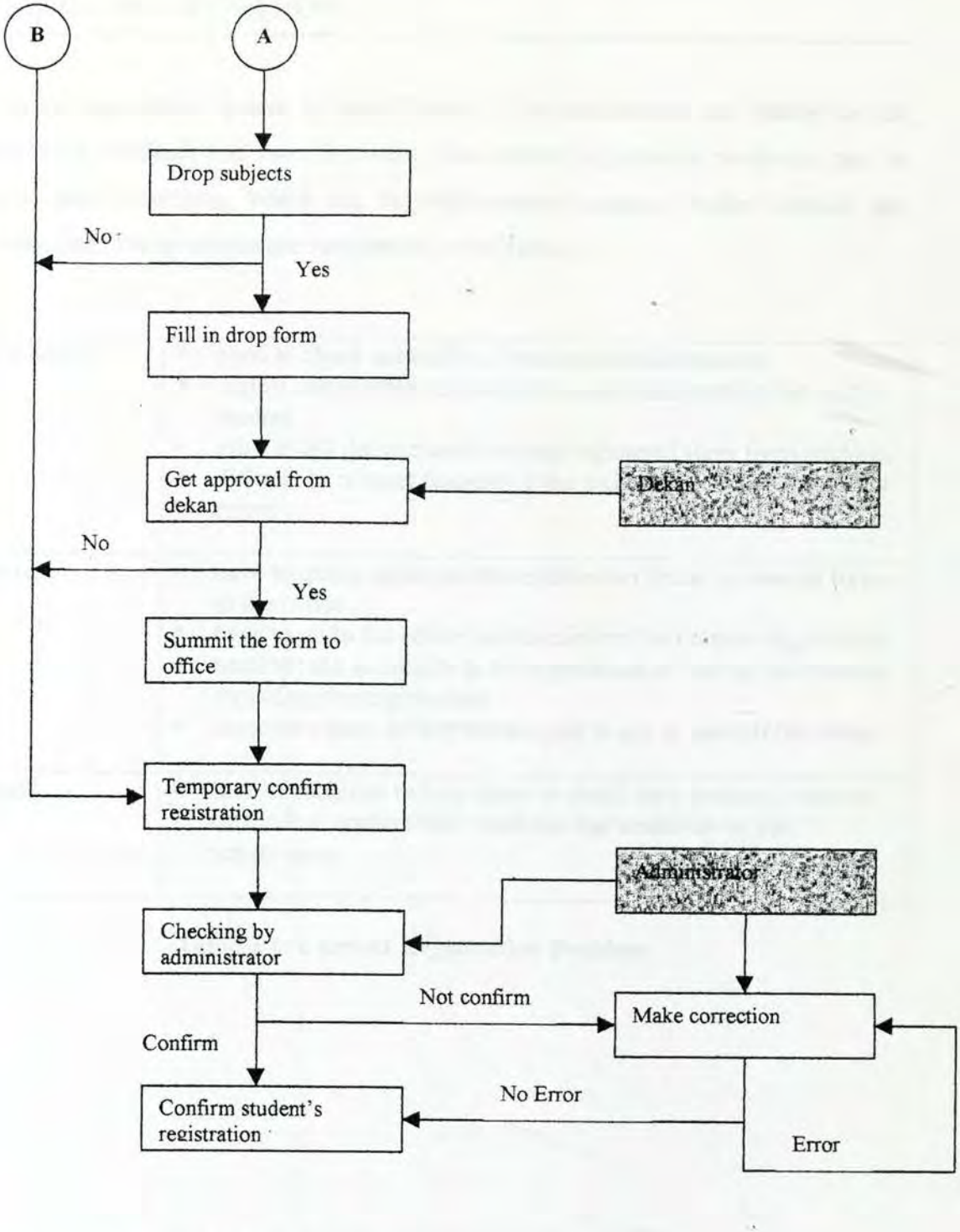


Figure 3.2 Student's course registration activities

3.2 PROBLEMS DEFINITION

The current registration system is not efficient. It is troublesome and handy for all administrators, students and even lecturers. The current registration problems can be categories into 3 sections, which are the administrator section, student section and lecturer section. The problems are summaries in the Table 3.1.

Administrators	▪ need to check manually all the registration process ▪ highly responsible on entry the correct information for each student ▪ must avoid the purposely wrong registered form from students ▪ difficult to contact students if the student registration form got errors
Students	▪ have to queue up to get the registration forms or summit forms to the office ▪ have to go to the office just to confirm the courses registration ▪ need to rush to faculty to do registration or asking information regarding the registration ▪ sometime have to skip classes just to get or summit the forms
Lecturers	▪ lack of facilities to help them to check their student's records ▪ difficult to contact their students that under his or her supervision

Table 3.1: Current Registration Problem

3.3 FUNCTIONAL REQUIREMENTS

The functional requirements can be categorized into 3 sections. These sections are entire system, student's modules and administrator's modules.

3.3.1 ENTIRE SYSTEM

- **Authentication and Authorization Module**

  This module is used to protect the system database from its unauthorized users. Authorize user will be provided a user identification and a password to access the system database.

- **Password Encryption Module**

  This module is used to encrypt and decrypt users password when the authorized users login into the system. Its is for the security purpose.

- **Change Password Module**

  This module enables users to change their password and user identification. Its objective is to maintenance a security environment.

3.3.2 STUDENTS MODULES

- **Course Registration Module**

  This module is used for students to select and summit their subjects to register for the next semester. It included several validation checking. It can be done only once but students can add and drop their registered subjects.

- **Course Information Module**

  This module enables students to view subjects, which are offered to register for the next semester. It provided information such as the subject credit hours, prerequisites and level.

- **Transcript Module**

  This module enables students to check their successful registered subjects during and after the registration closing date.

3.3.3 ADMINISTRATORS MODULES

- **Access Level Module**

  This module enables system administrators to define their own administrator access level as they wish.

- **Course Maintenance Module**

  This module is used for administrators to customize or change subject's particulars such as subject code, category, level and credit hour.

- **Offer Courses Module**

  This module enables administrators to open or close subjects for a particular semester.

- **Registration Rules Maintenance Module**

  This module is used to set up rules for the course registration. It is used for the validation of student's registration. Some of the rules included credit hours, prerequisites and industrial training rules.

- **Courses Registration Approving Module**

  This module helps administrators to approve students course registration. Once students registration are approved, it is consider confirm by the faculty.

3.4 NON-FUNCTIONAL REQUIREMENTS

Non-functional requirements are essential definition of system properties and constraints under which a system must operate. Although the non-functional requirements are subjective, they are as important as the functional requirements.

- **Reliability**

  It is reliability if the application system, software and hardware do not cause unnecessary failure or downtime when they are used in a reasonable manner.

- **Usability**

  The application systems shall be easy to use. There should be no complex and unnecessary step to perform. They shall enhance and support rather than limit or restrict business processes.

- **User-friendly**

  The application system required having a user-friendly interface for the ease of usage. Graphical User Interface approach should apply for better visual effect to the user. Effective error handling and validation will also help the user to navigate to the system with more confidence. Error message should be display to the user to indicate what is going wrong rather than for the user to guest what is happening.

- **Respond Time**

  The respond time should be within a reasonable interval time in retrieving any data or information. Good application systems should have a shorter respond time.

- **Maintainability and Expandability**

  The architecture and database design should be able to maintain and can be extended if necessary amendment is required in the future.

- **Security**

The application system shall be able to prevent unauthorized users access to the system.

- **Manageability**

  The application system, hardware and software shall be capable of being managed and easy to operate.

- **Robustness**

  The application system shall be able to handle or at least avoid disaster in the face of unexpected data.

3.5 METHODOLOGY

The waterfall model with prototyping has been chosen as the system process model. Figure 3.1 shows the waterfall model with prototyping [Pfleeger, S.L, 1996] for this project.

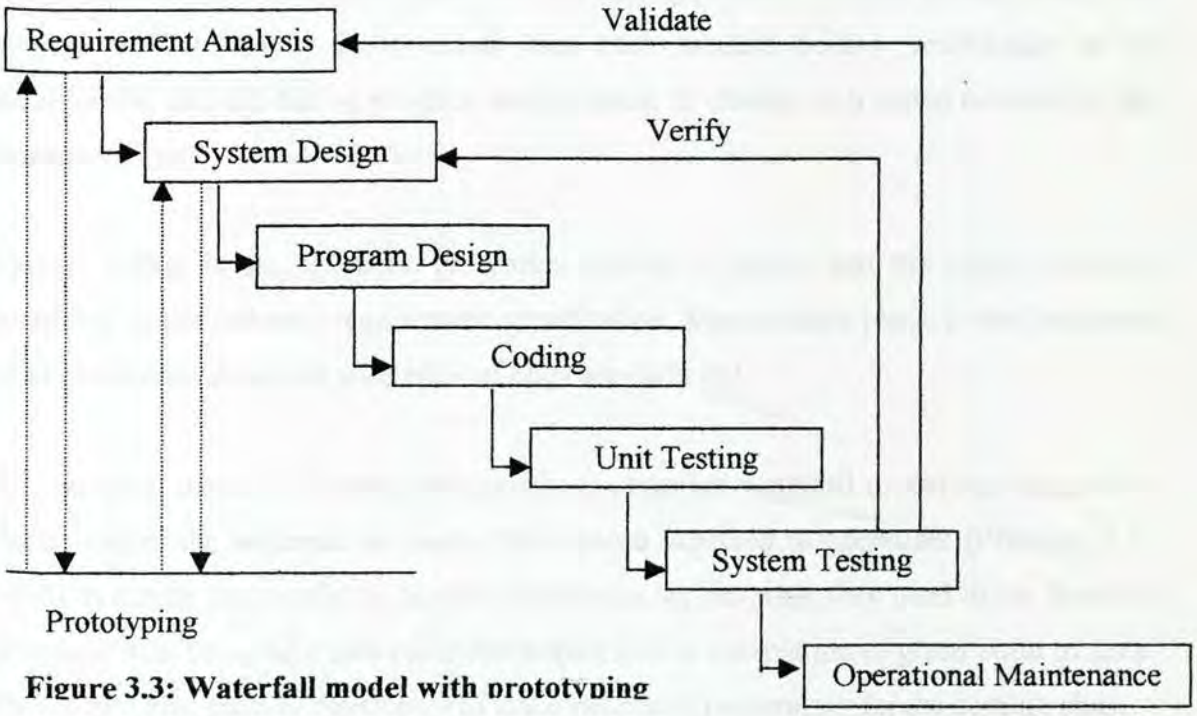


Figure 3.3: Waterfall model with prototyping

This system process model contains seven phases, which are the requirement analysis, system design, program design, coding, unit testing, system testing and operational maintenance. The first phase in this methodology is requirement analysis, which require information gathering. It may be in technical aspect or non-technical aspect. Information will be gathered through the Internet, conduct interview and reading materials. The materials may include journals, magazines, books and newspaper. This is the phase where research and survey are done.

System design involved in designing a system and determining what a system does and not how it works. The next phase after the system design phase is the program design phase. Program design is the phase where algorithms are define and document for each module in the design tree that will be realized as code. It involves drafting out data flow diagrams that resembles the functionality of the system and its subsystem.

Meanwhile, coding phase involved in transforming the algorithms defined during the previous phases into a computer understandable language. The program will be coded using selected programming languages and application development tools following the design specification. The next phase after the coding phase is the unit testing phase. The purpose of unit testing is to ensure that each module behave accordingly to its specification defined during program design phase. It checks each coded module for the presence of bug.

System testing is use to check the entire system to ensure that the system behaves according to the software requirement specification. Maintenance phase is the last phase where continues detection and repair of bugs are carry out.

The waterfall model with prototyping is chosen because waterfall model can suggests to the developer the sequence of events they should expected to encounter [Pfleeger, S.L, 1996]. It can be very useful in helping developers lay out what they need to do. Besides, developer also can gauge how close the project was to completion to given point of time. This model also enables developers to make necessary preparation for the coming phase.

Prototyping is used with waterfall model because it can help the developers to enhance their understanding about the system [Pfleeger, S.L, 1996]. Prototyping is the technique of constructing a partial implementation of a system so that users or developers can learn more about a problem or solution to that problem. It causes the entire system to be construct quickly.

The prototyping approach is based on the premise that users do not know exactly what they want until they actually have a chance to see and work with the system or part of the system. The system developers then build the system using the feedback supplied by the users.

There are two primary school of prototyping methodology, which are throwaway and evolutionary [David, A, 1993]. In the throwaway approach, the prototype is constructed in order to learn more about the problem or its solution. Once the desired knowledge is gained, the prototype is discard. In the evolutionary approach, the prototype is constructed in order to learn more about the problem or its solution. Once the requisite knowledge gained, the prototype is then adapted to satisfy the better understood needs. The prototype is then use again and re-adapted. For this project, evolutionary approach will be used. The figure [Alavi, M, 1984] below shows the Student Information System prototyping approach.

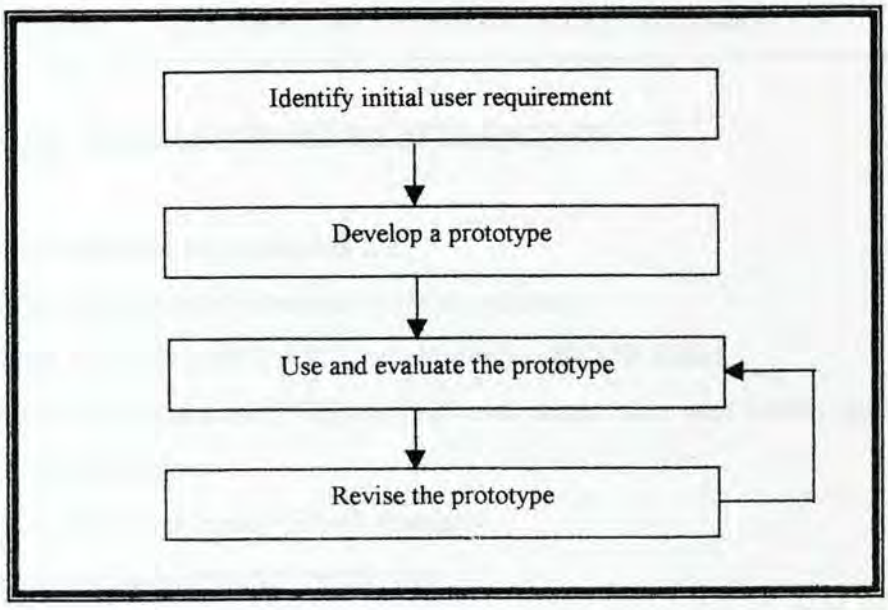


Figure 3.4: SIS prototyping approach

In the prototyping approach, the user requirement will be identified and documented. This information will be used to develop user interface and will be tested as prototype. Prototyping enable the users to interact with the system so that they have a better understanding what the new system will be. All the feedback from the users will be used to re-adapt the prototype in order to satisfy the users needs. The prototype is then use again and re-adapted until satisfy by the developers and users.

Prototyping approach is use when the system development life cycle fails to meet the users' requirements. Thus the system had to be reworked requiring additional effort, expense and time. The system is not delivered on time and it exceeds the budget [Isensee, S, 1996].

The reasons why the prototype methodology is important are show below.

- Requirements are often poorly understood [David, A, 1993]
- Requirements usually change during the development process [David, A, 1993]
- Current requirements remain only partially understood until after users have had an actual opportunity to use a system [David, A, 1993]

3.6 HARDWARE AND SOFTWARE REQUIREMENTS

3.6.1 SERVER HARDWARE REQUIREMENTS

The server computer requirements are:

1. A server with at least Pentium 166Mhz processor.
2. At least 32 Megabytes RAM – recommended 64 MB RAM.
3. Network Interface Card (NIC) and network connection with recommended bandwidth at 10Mbps or more.
4. A hard disk for at least 1 GB of storage.
5. Others standard computer peripherals

3.6.2 SERVER SOFTWARE REQUIREMENTS

To host and run the system, the server computer needs to have various supporting software installed.

Software/Component	Description
Windows NT Server 4.0	Network operating system
Internet Information Server 4.0	Web-server service
Active Server Pages	Server Scripting Engine
Microsoft SQL Server 7.0	RDBMS for data warehousing
Microsoft Internet Explorer 4	Precondition for ASP installation

Table 3.2: Server Software Requirements

3.6.3 CLIENT HARDWARE REQUIREMENTS

The client hardware requirements are quite minimal as long as it has a reasonable amount of RAM and a reasonable quality dial-up connection line. The recommended configurations are:

1. At least 16 Megabytes of RAM.
2. A minimum 150 MB of hard disk storage.
3. Network connection through existing network configuration or modem (recommended at least 14.4 kbps).

3.6.4 CLIENT SOFTWARE REQUIREMENTS

Client needs to have the basic Microsoft operating system such as Windows 3x or Windows 95 as a basic requirement to install other software to support the system. As for compatibility reason, Microsoft products are recommended. The client software requirements fall on the browser used by users. It requires a system that can run Microsoft Internet Explorer 4 and above or any other browsers that support ActiveX and VBScript.

Chapter 4 System Design

System design is one of the phases in the system development where requirements for the system are translated into the system characteristics. There are three stages in the design process in this project. The three stages are architecture design, user interface design and database design.

4.1 OVERVIEW OF SYSTEM ARCHITECTURE

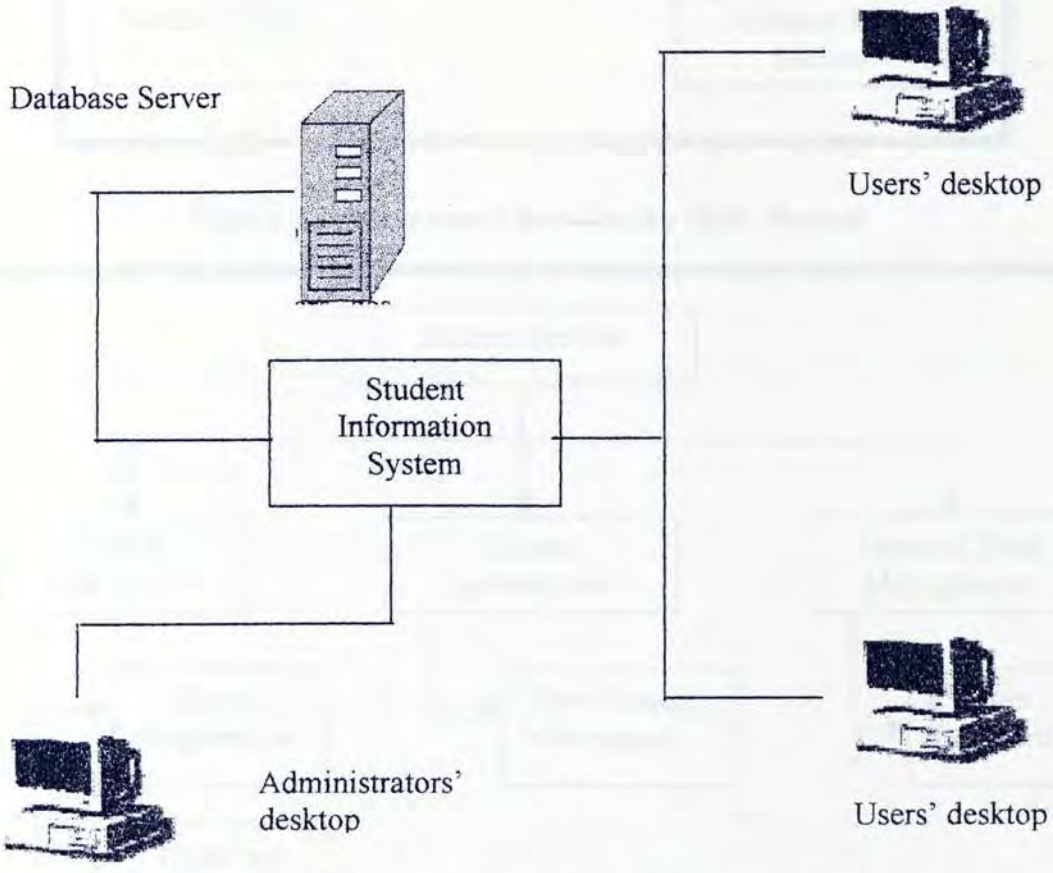


Figure 4.1: Overview of SIS architecture

4.2 ARCHITECTURE DESIGN

Architecture design is important in identifies the sub-systems that make up the system and their relationships. Each sub-system has its own function but it may relate with other sub-system to form a larger system. SIS consists of two main sections which are Student Section and Administrator Section.

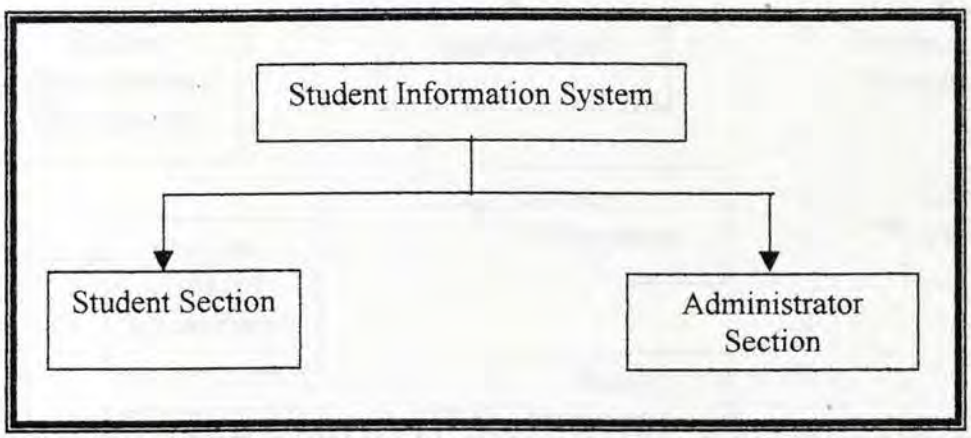


Figure 4.2: Structure Chart for the Main System

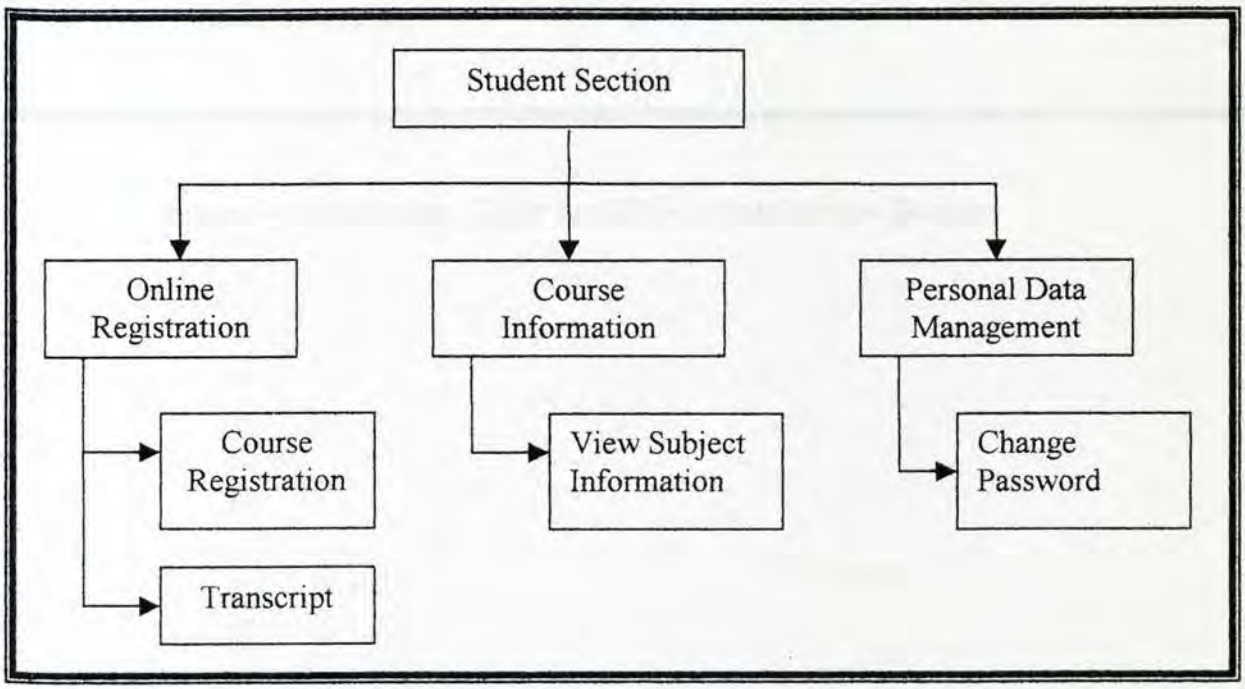


Figure 4.3: Structure Chart for SIS – Student Section

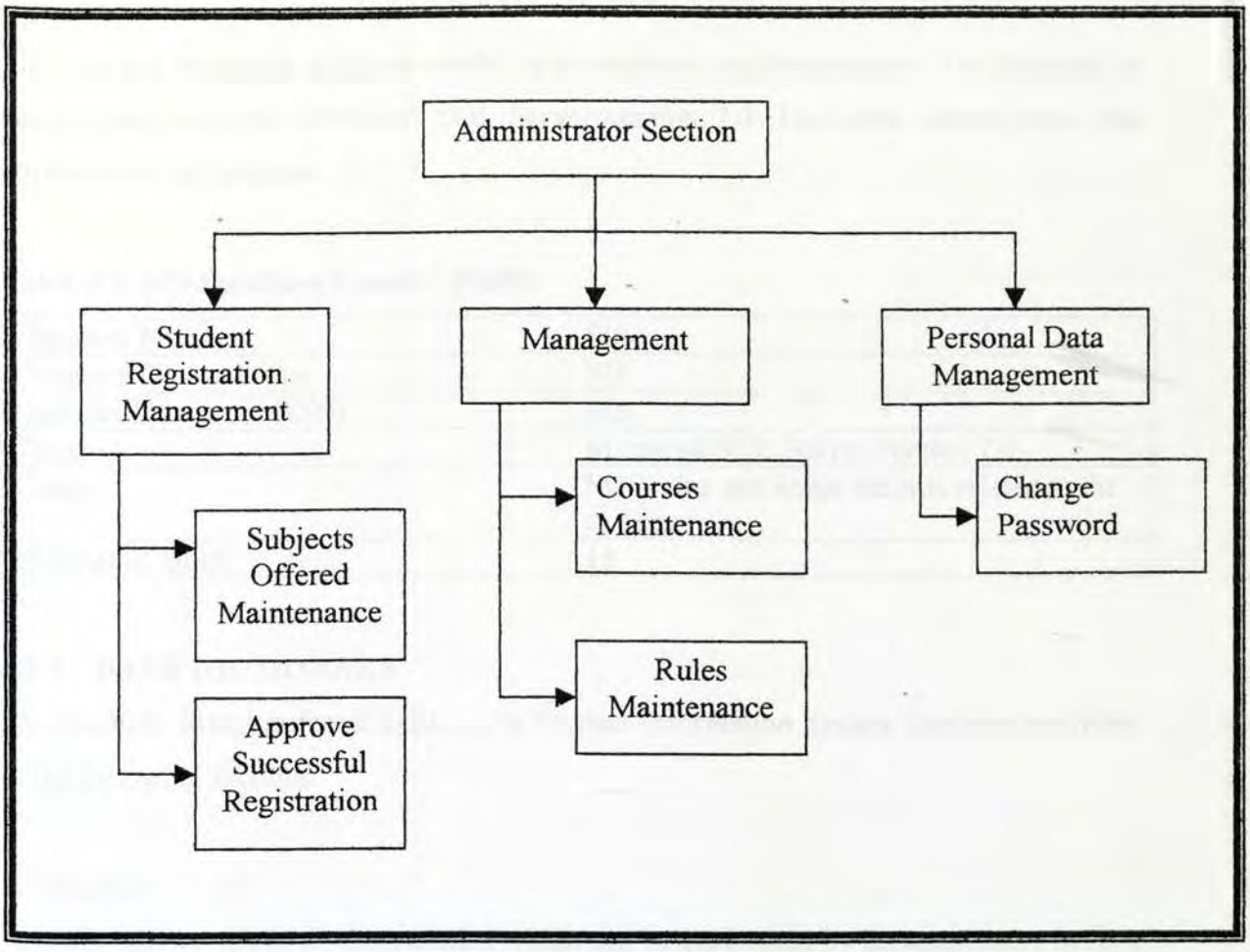


Figure 4.4: Structure Chart for SIS – Administrator Section

4.3 DATABASE DESIGN

SIS uses the relational database model in its database implementation. The database is constructed using the Microsoft SQL Server version 7.0. The table below shows the attributes of the database.

Table 4.1: SIS Database General Profile

Database Name	SIS
Database Device Name	SIS
Data Source Name (DSN)	SIS
Type	Microsoft SQL Server version 7.0
Usage	Maintains and keeps records related to the system
Number of tables	18

4.3.1 DATA DICTIONARY

The database structure for all relations in Student Information System database are listed in the following sections.

1. Module

This relation stores all the modules which can be performed by administrators in SIS. It consists of 1 primary key which is ModID.

Table 4.2: Data Structure of Module

Column Name	Column Description	Data Type (Length)	Required	Attribute Type
ModID	Mod identification	VARCHAR(10)	Y	OWNED KEY
ModDesc	Description	VARCHAR(50)	Y	OWNED NON-KEY

2. Menu

This relation stores all the menu which can be performed by administrators in SIS. It consists of 1 primary key which is MenuID.

Table 4.3: Data Structure of Menu

Column Name	Column Description	Data Type (Length)	Required	Attribute Type

MenuID	Menu identification	VARCHAR(20)	Y	OWNED KEY
MenuDesc	Description	VARCHAR(50)	Y	OWNED NON-KEY

3. LoginAccount

This relation keeps all the users login information. It defines their LoginID, Password and LevelID.

Table 4.4: Data Structure of LoginAccount

Column Name	Column Description	Data Type (Length)	Required	Attribute Type
LoginID	Login identification	VARCHAR(20)	Y	OWNED KEY
Password	Password	VARCHAR(20)	Y	OWNED NON-KEY
LevelID	Level identification	VARCHAR(10)	Y	OWNED NON-KEY

4. LoginControl

This relation uses to keep track user access information to the system. It consists of 1 primary key which is LoginID.

Table 4.5: Data Structure of LoginControl

Column Name	Column Description	Data Type (Length)	Required	Attribute Type
LoginID	Login identification	VARCHAR(20)	Y	OWNED KEY
LoginDate	Login date	DATETIME	N	OWNED NON-KEY
LoginTime	Login time	DATETIME	N	OWNED NON-KEY
LogoutDate	Logout date	DATETIME	N	OWNED NON-KEY
LogoutTime	Logout time	DATETIME	N	OWNED NON-KEY

5. ModMenu

This relation stores module identification and menu identification which can be performed by administrators in SIS. It consists of 1 primary key which is ModMenuID.

Table 4.6: Data Structure of ModMenu

Column Name	Column Description	Data Type (Length)	Required	Attribute Type
ModMenuID	Module-Menu identification	INT	Y	OWNED KEY
ModID	Mod identification	VARCHAR(10)	Y	OWNED NON-KEY
MenuID	Menu identification	VARCHAR(20)	Y	OWNED NON-KEY

6. UserModMenu

This relation is actually a bridge between ModMenu and LogibAccount. Thus it defines all the tasks that can be performed by each login identification. It consists of 2 composite keys which are LoginID and ModMenuID. These keys are actually foreign keys from table LoginAccount and ModMenu respectively.

Table 4.7: Data Structure of UserModMenu

Column Name	Column Description	Data Type (Length)	Required	Attribute Type
LoginID	Login identification	VARCHAR(20)	Y	OWNED KEY
ModMenuID	Module-Menu identification	INT	Y	OWNED KEY

7. UserLevel

This relation keeps all the access level for the administrators in the SIS. It consists of one composite keys which is LevelID.

Table 4.8: Data Structure of UserLevel

Column Name	Column Description	Data Type (Length)	Required	Attribute Type
LevelID	Level identification	VARCHAR(10)	Y	OWNED KEY
LevelDesc	Description	VARCHAR(50)	Y	OWNED NON-KEY

8. Course

This relation keeps all the course particulars. All the courses have a unique course identification which is their primary key.

Table 4.9: Data Structure of Course

Column Name	Column Description	Data Type (Length)	Required	Attribute Type
CourseID	Course code	VARCHAR(10)	Y	OWNED KEY
Name	Course name	VARCHAR(50)	Y	OWNED NON-KEY
CreditHour	Course credit unit	INT	Y	OWNED NON-KEY
Limit	Limit Constraint	INT	Y	OWNED NON-KEY
Sem1	First Semester	INT	Y	OWNED NON-KEY
Sem2	Second Semester	INT	Y	OWNED NON-KEY
Sem3	Third Semester	INT	Y	OWNED NON-KEY
CourseLevelID	Course level	INT	Y	OWNED NON-KEY
CategoryID	Category identification	VARCHAR(10)	Y	OWNED NON-KEY
DepartmentID	Department identification	VARCHAR(10)	N	OWNED NON-KEY
FacultyID	Faculty identification	VARCHAR(10)	Y	OWNED NON-KEY
Offer	Offer	INT	Y	OWNED NON-KEY

Prerequisite	Prerequisite	INT	Y	OWNED NON-KEY
CountGPA	Count GPA	INT	N	OWNED NON-KEY
LastUpdate	Last update	DATETIME	Y	OWNED NON-KEY
UserID	User identification	VARCHAR(20)	Y	OWNED NON-KEY

9. PreCourse

This relation contains the prerequisite information for course that has them. It consists of one main composite key which are CourseID.

Table 4.10: Data Structure of PreCourse

Column Name	Column Description	Data Type (Length)	Required	Attribute Type
CourseID	Course code	VARCHAR(20)	Y	OWNED KEY
Level1	Initial level	INT	N	OWNED NON-KEY
Level2	Middle level	INT	N	OWNED NON-KEY
TypeL1A	Category 1 – level1	VARCHAR(20)	N	OWNED NON-KEY
TypeL1B	Category 2 – level1	VARCHAR(20)	N	OWNED NON-KEY
TypeL1C	Category 3 – level1	VARCHAR(20)	N	OWNED NON-KEY
TypeL2A	Category 1 – level2	VARCHAR(20)	N	OWNED NON-KEY
TypeL2B	Category 2 – level2	VARCHAR(20)	N	OWNED NON-KEY
TypeL2C	Category 3 – level2	VARCHAR(20)	N	OWNED NON-KEY
Course1	Course1	VARCHAR(20)	N	OWNED NON-KEY
Course2	Course2	VARCHAR(20)	N	OWNED NON-KEY
Course3	Course3	VARCHAR(20)	N	OWNED NON-KEY
Exclude1	Exclude1	VARCHAR(20)	N	OWNED NON-KEY
Exclude2	Exclude2	VARCHAR(20)	N	OWNED NON-KEY
Exclude3	Exclude3	VARCHAR(20)	N	OWNED NON-KEY
LastUpdate	Last update	DATETIME	N	OWNED NON-KEY
UserID	User identification	VARCHAR(20)	N	OWNED NON-KEY

10. TempRegister

This relation stores all the students' course registration temporary for a particular session. It consists of 4 keys which are LoginID, CourseID, Semester and Session. Once the students' course registration has been approved, its data will be posted to the Register table.

Table 4.11: Data Structure of TempRegister

Column Name	Column Description	Data Type (Length)	Required	Attribute Type
LoginID	Login identification	VARCHAR(20)	Y	OWNED KEY
Session	Session	VARCHAR(20)	Y	OWNED KEY
Semester	Semester	INT	Y	OWNED KEY
CourseID	Course code	VARCHAR(20)	Y	OWNED KEY

LastUpdate	Last update	DATETIME	N	OWNED NON-KEY
UserID	User identification	VARCHAR(20)	N	OWNED NON-KEY

11. Register

This relation stores all the students' course registration for every session. It consists of 4 keys which are LoginID, CourseID, Semester and Session.

Table 4.12: Data Structure of Register

Column Name	Column Description	Data Type (Length)	Required	Attribute Type
LoginID	Login identification	VARCHAR(20)	Y	OWNED KEY
Session	Session	VARCHAR(20)	Y	OWNED KEY
Semester	Semester	INT	Y	OWNED KEY
CourseID	Course code	VARCHAR(20)	Y	OWNED KEY
CreditHour	Credit Hour	INT	N	OWNED NON-KEY
Try	Try	INT	N	OWNED NON-KEY
PassFlag	Passing flag	INT	N	OWNED NON-KEY
Grade	Result Grade	VARCHAR(10)	N	OWNED NON-KEY
LastUpdate	Last update	DATETIME	N	OWNED NON-KEY
UserID	User identification	VARCHAR(20)	N	OWNED NON-KEY

12. CreditRules

This relation keeps the number of credit hours which allow to register base on students' result (PNG). It consists of three composite keys which is FrmGPA, ToGPA and CreditHour.

Table 4.13: Data Structure of CreditRules

Column Name	Column Description	Data Type (Length)	Required	Attribute Type
FrmGPA	Lower bound of PNG	FLOAT	Y	OWNED KEY
ToGPA	Upper bound of PNG	FLOAT	Y	OWNED KEY
CreditHour	Credit unit	INT	Y	OWNED KEY
LastUpdate	Last update	DATETIME	Y	OWNED NON-KEY
UserID	User identification	VARCHAR(20)	Y	OWNED NON-KEY

13. Faculty

This relation stores the faculty identification and name. It consists of one composite key which is FacultyID.

Table 4.14: Data Structure of Faculty

Column Name	Column Description	Data Type (Length)	Required	Attribute Type
FacultyID	Faculty identification	VARCHAR(10)	Y	OWNED KEY
Name	Name	VARCHAR(100)	Y	OWNED NON-KEY
LastUpdate	Last update	DATETIME	Y	OWNED NON-KEY
UserID	User identification	VARCHAR(20)	Y	OWNED NON-KEY

14. Department

This relation stores the department identification and name. It consists of one composite key which is DepartmentID.

Table 4.15: Data Structure of Department

Column Name	Column Description	Data Type (Length)	Required	Attribute Type
DepartmentID	Department identification	VARCHAR(10)	Y	OWNED KEY
Name	Name	VARCHAR(50)	Y	OWNED NON-KEY
LastUpdate	Last update	DATETIME	Y	OWNED NON-KEY
UserID	User identification	VARCHAR(20)	Y	OWNED NON-KEY

15. Category

This relation stores the category identification and name. It consists of one composite key which is CategoryID.

Table 4.16: Data Structure of Category

Column Name	Column Description	Data Type (Length)	Required	Attribute Type
CategoryID	Category identification	VARCHAR(10)	Y	OWNED KEY
Name	Name	VARCHAR(50)	Y	OWNED NON-KEY
LastUpdate	Last update	DATETIME	Y	OWNED NON-KEY
UserID	User identification	VARCHAR(20)	Y	OWNED NON-KEY

16. Submission

This relation keeps the submission identification list for a particular semester. It consists of four composite keys which are SubmitID, Year1, Year2 and Semester.

Table 4.17: Data Structure of Submission

Column Name	Column Description	Data Type (Length)	Required	Attribute Type
SubmitID	Submission identification	VARCHAR(20)	Y	OWNED KEY
Year1	Year1	INT	Y	OWNED KEY
Year2	Year2	INT	Y	OWNED KEY
Semester	Semester	INT	Y	OWNED KEY
Active	Active flag	INT	Y	OWNED NON-KEY

17. Submit1

This relation keeps the student identification when he or she has register or submit his or her PPO1 form. It consists of one composite key which is LoginId.

Table 4.18: Data Structure of Submit1

Column Name	Column Description	Data Type (Length)	Required	Attribute Type
LoginID	Login identification	VARCHAR(10)	Y	OWNED KEY
SubmitDate	Submission Date	VARCHAR(50)		OWNED NON-KEY

18. Submit2

This relation keeps the student identification when he or she has register or submit his or her Add/Drop form. It consists of one composite key which is LoginId.

Table 4.19: Data Structure of Submit2

Column Name	Column Description	Data Type (Length)	Required	Attribute Type
LoginID	Course group identification	VARCHAR(10)	Y	OWNED KEY
SubmitDate	Course group name	VARCHAR(50)		OWNED NON-KEY

4.3.2 RELATIONSHIP

The relationship for SIS database are as followed:

1. Access Level – Function Perform
   - Many : Many
   - Each Access Level may perform many functions
   - Each function may be categorised under many access level
   - The link between this two entity is the AccessDesc relation (a bridge relation)

2. Administrator – Access Level
   - Many : 1
   - Each administrator may just has one access level
   - Each access level may be contains of many administrators

3. Administrator – Login Account
   - 1 : 1
   - Each administrator may just has one login account
   - Each login account may just contains one administrator

4. Student – Login Account
   - 1 : 1
   - Each student may just has one login account
   - Each login account may just contains one student

5. Student – Course
   - Many : Many
   - Each student may register for many courses
   - Each course may be registered by many students

6. Student – Session

- Many – 1
- Each student may just register for 1 session
- Each session may be registered by many students

7. CourseGroup – Course
   - 1 – Many
   - Each course group may has many courses
   - Each course may just categorised in 1 course group

The diagrammatic representation of SIS is illustrated in the Entity-Relationship (E-R) diagram below.

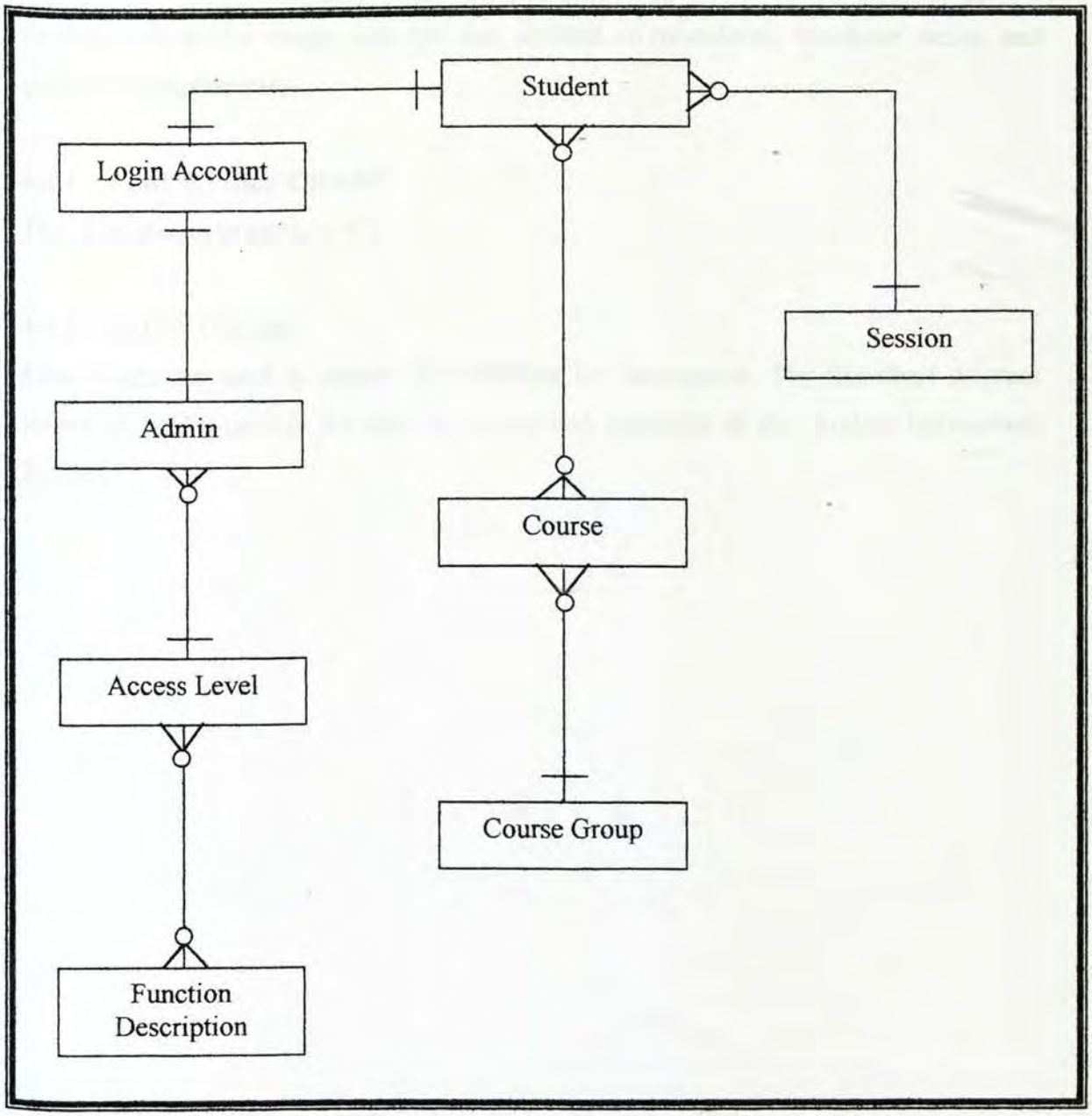


Figure 4.5: E-R Diagram for SIS

4.4 PROCESS DESIGN

There are several design methodologies for the process design. SIS is designed based on the data flow oriented-design method or structured design. Data flow oriented-design has its origins in earlier design concepts that stressed on modularity, top-down design and structured programming.

4.4.1 STRUCTURE CHART

This is as shown in sections 4.2

4.4.2 FLOW CHART

Flow charts are used to depict the workflow for the system. The flowchart diagram shown as below depicts the flow of events and instances of the Student Information System.

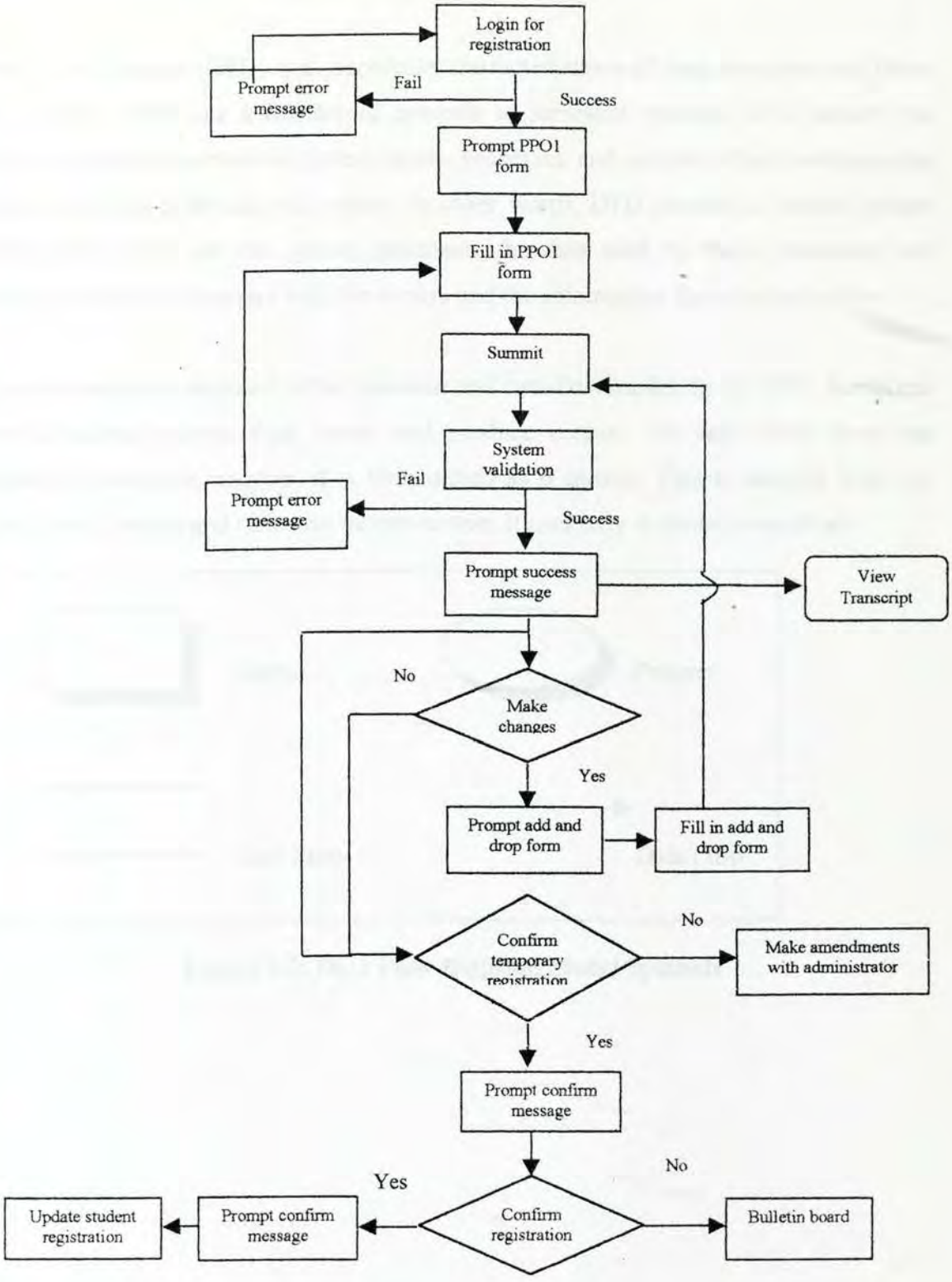


Figure 4.6: Flow Chart for Course Registration

4.4.3 Data Flow Diagram

Data Flow Diagram (DFD) is a graphically characterization of data processes and flows in a system. DFD use a number of symbols to represent systems. DFD depicts the broadest possible overview of system inputs, processes, and outputs; which corresponded to data movement through the system. In other words, DFD consists of model system components which are the system processes, the data used by these processes, any external entities that interact with the system and the information flows in the system.

A process model is depicted in the flowchart and data-flow model. In the DFD, functional transformations process their inputs and produce outputs. As data flows from one numbered process to another, it is transformed as it moves. This is adapted from the *Myers and Yourdon* and *Constantine* convention. It uses only 4 symbols which are :

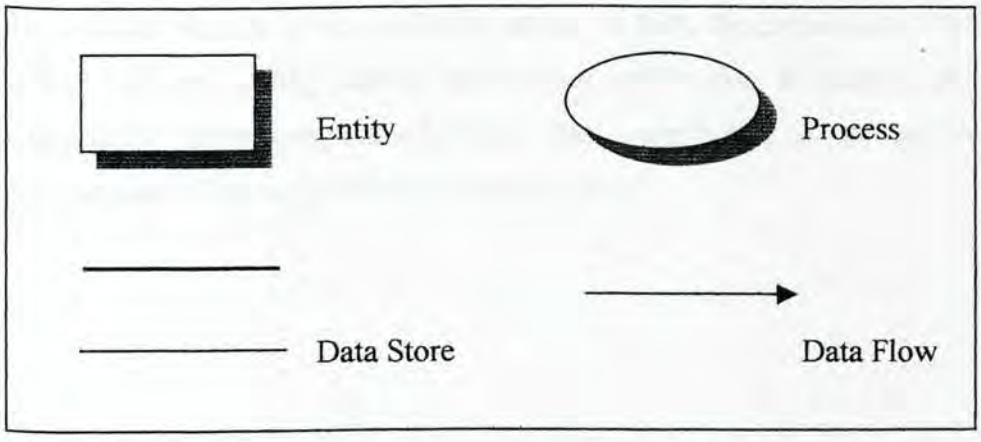


Figure 4.7: Data Flow Diagram Model Symbols

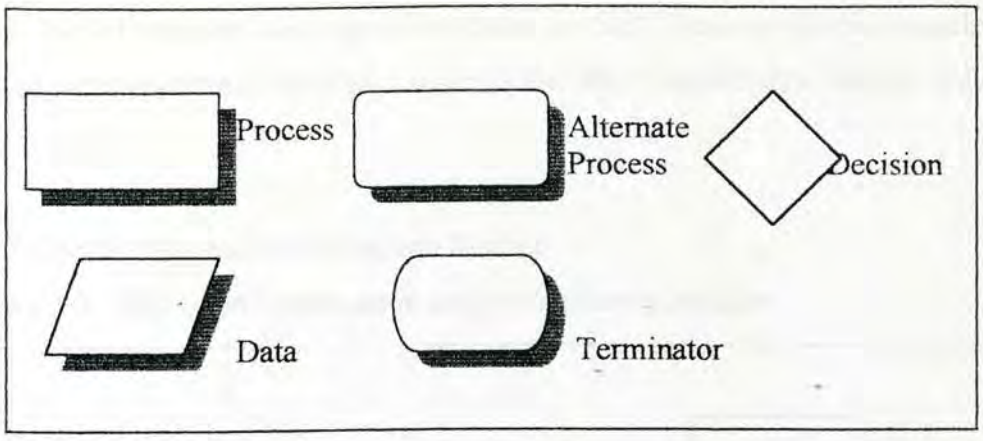


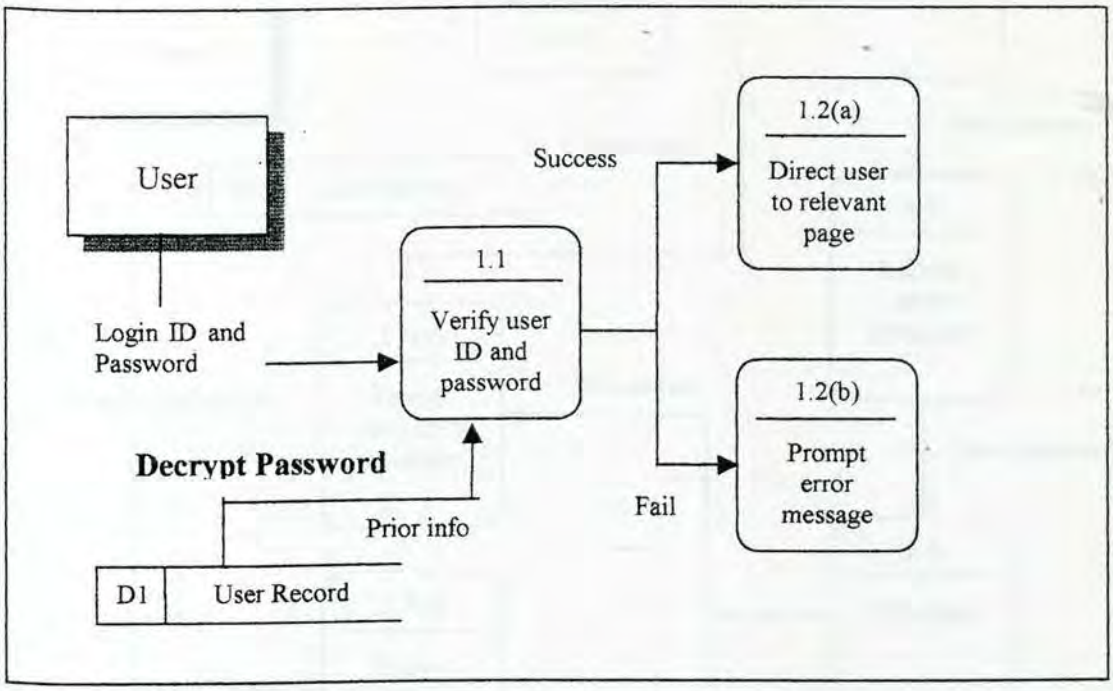
Figure 4.8: Flowchart Model Symbols

Overall development process in the SIS system follows the waterfall model in software engineering, every testing and evaluation is used to validate the system requirements with the problem persists or new solution arises. In fact, the preliminary studies for system coding and unit testing deploy throw-away prototyping to achieve the requirements. Exploratory prototyping development has contributed a lot in the incremental development of the requirement and design itself.

There are all together three type of modules for SIS. These are global module which are shared among administrators and students and their respectively module. Below are the DFD for SIS.

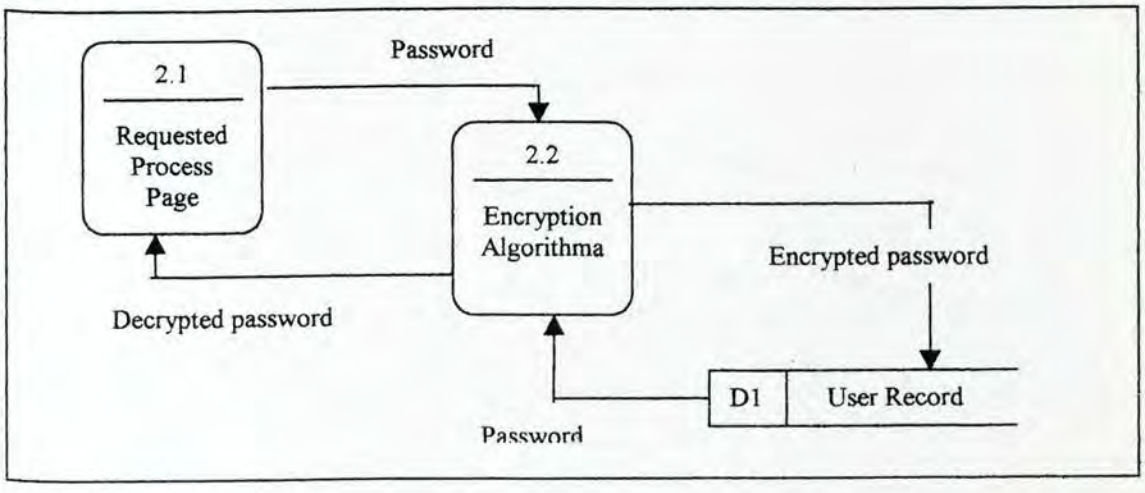
- Authentication and Authorisation Module

Figure 4.9: DFD for Authentication and Authorisation Module



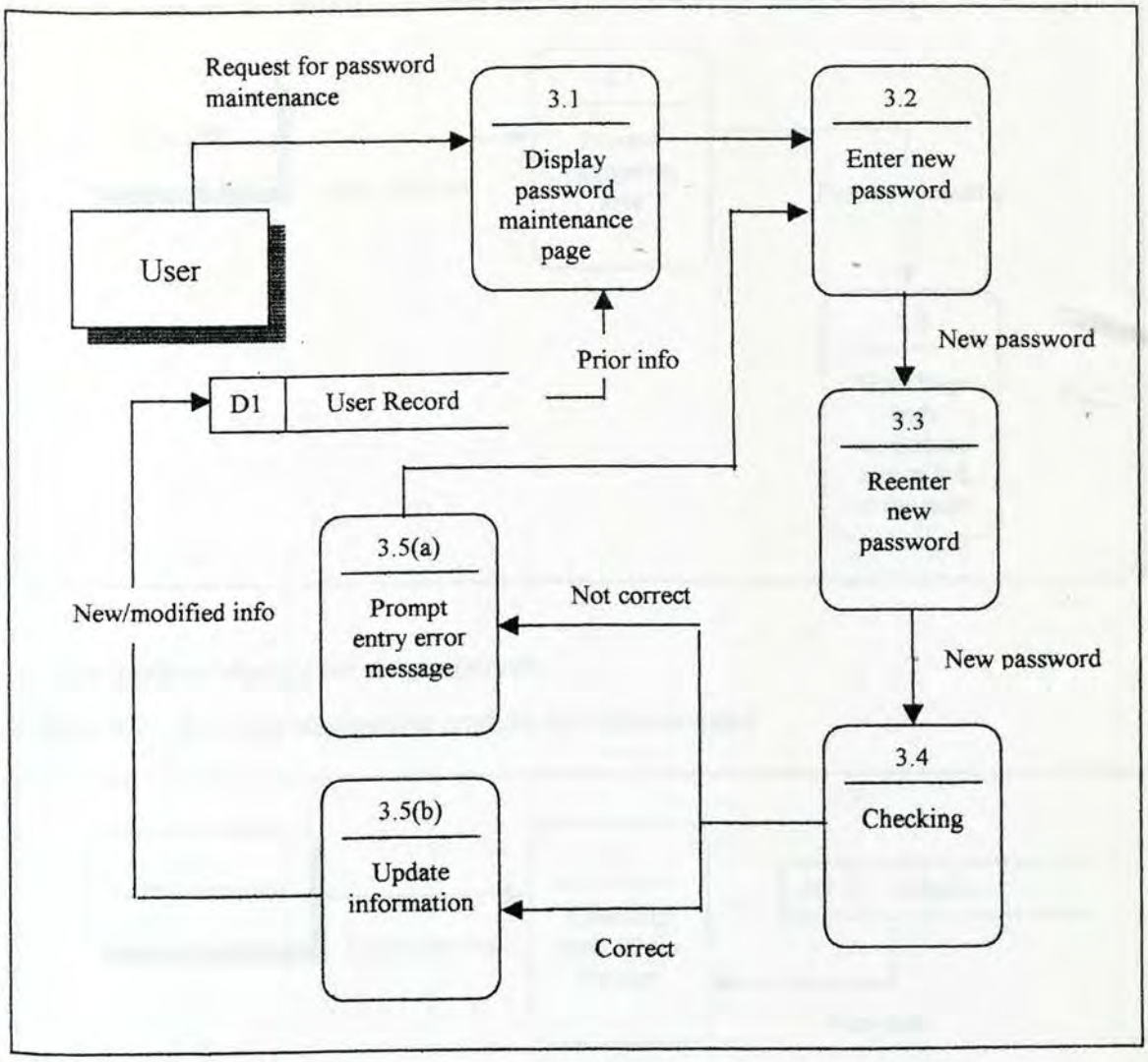
- Password Encryption Module

Figure 4.10: DFD for Password Encryption Module



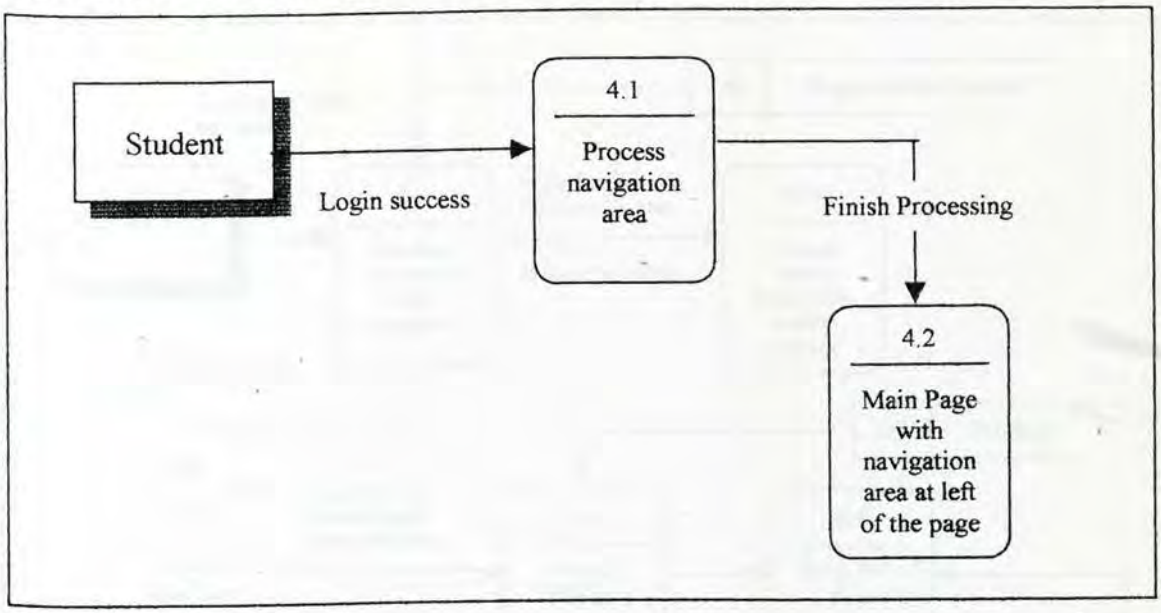
- Personal Data Management Module

Figure 4.11: DFD for Personal Data Management Module (Password Maintenance)



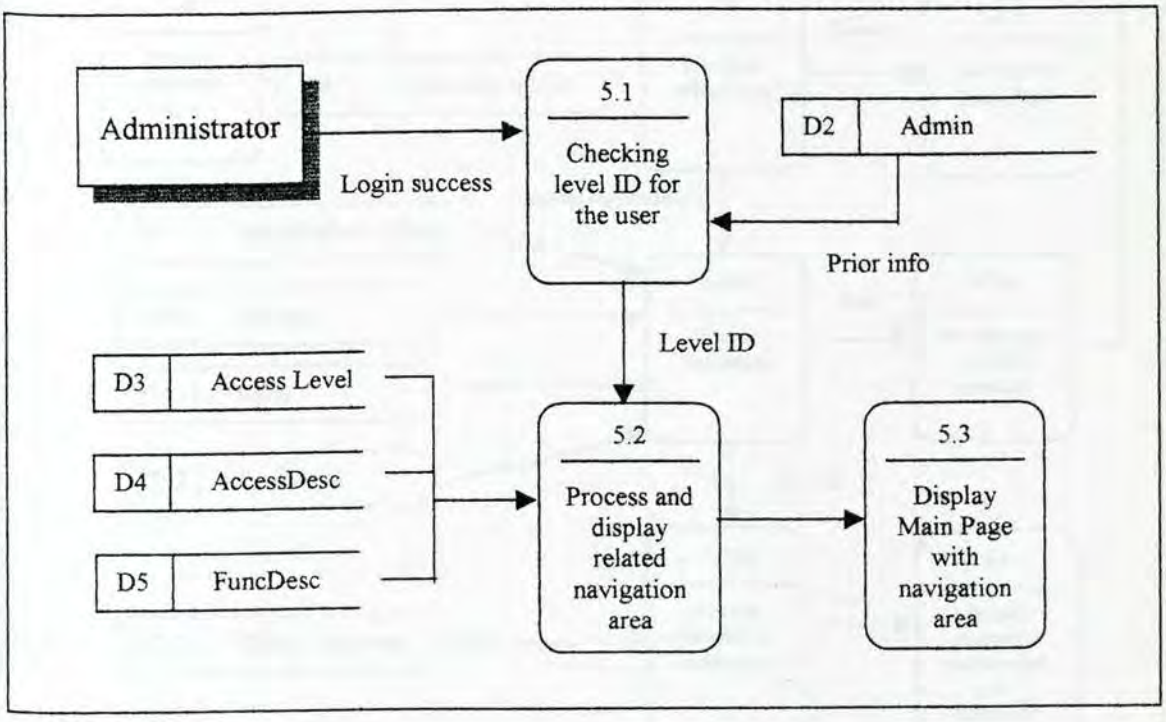
- Navigation Module for Student

Figure 4.12: DFD for navigation module for student



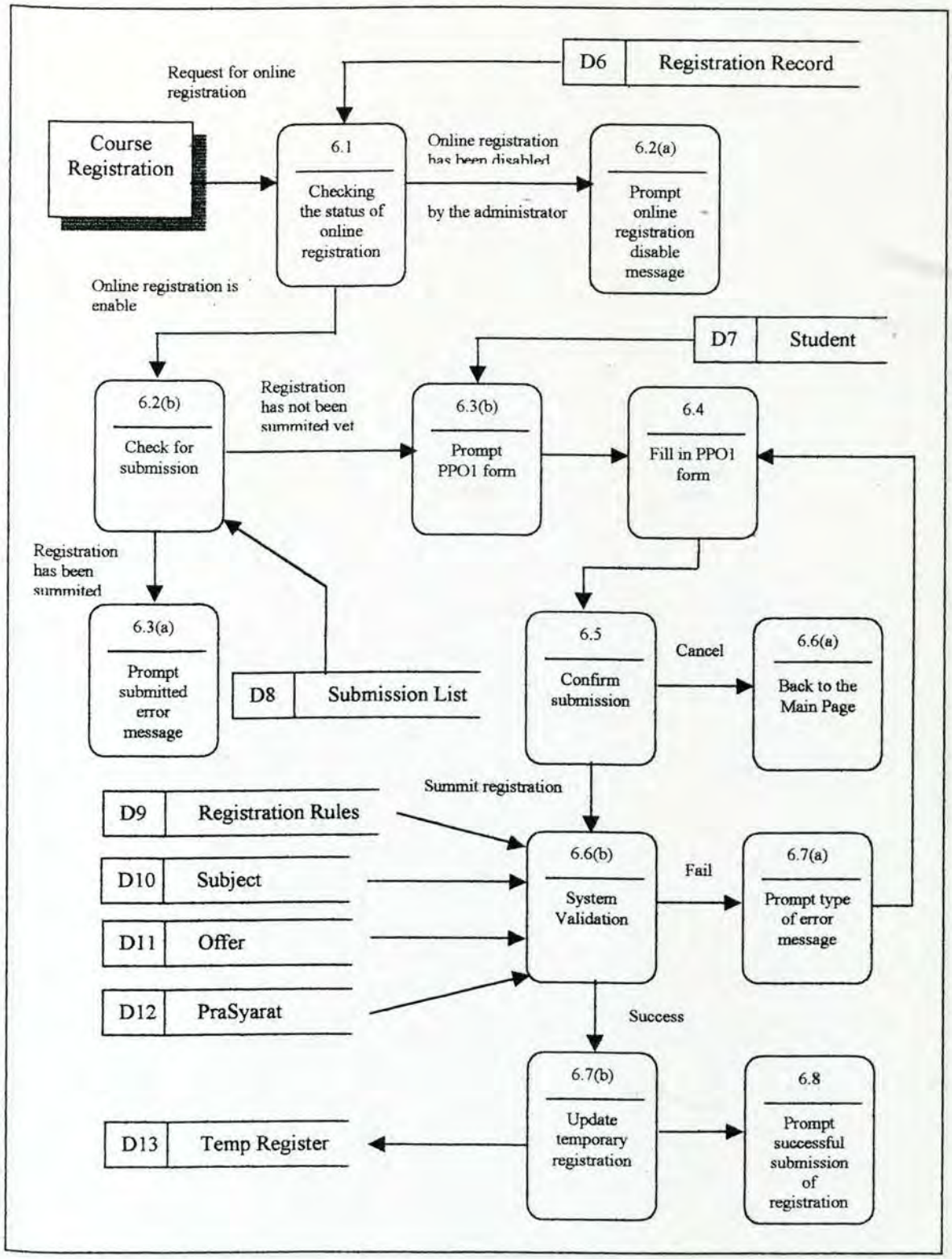
- Navigation Module for Administrator

Figure 4.13: DFD for navigation module for administrator



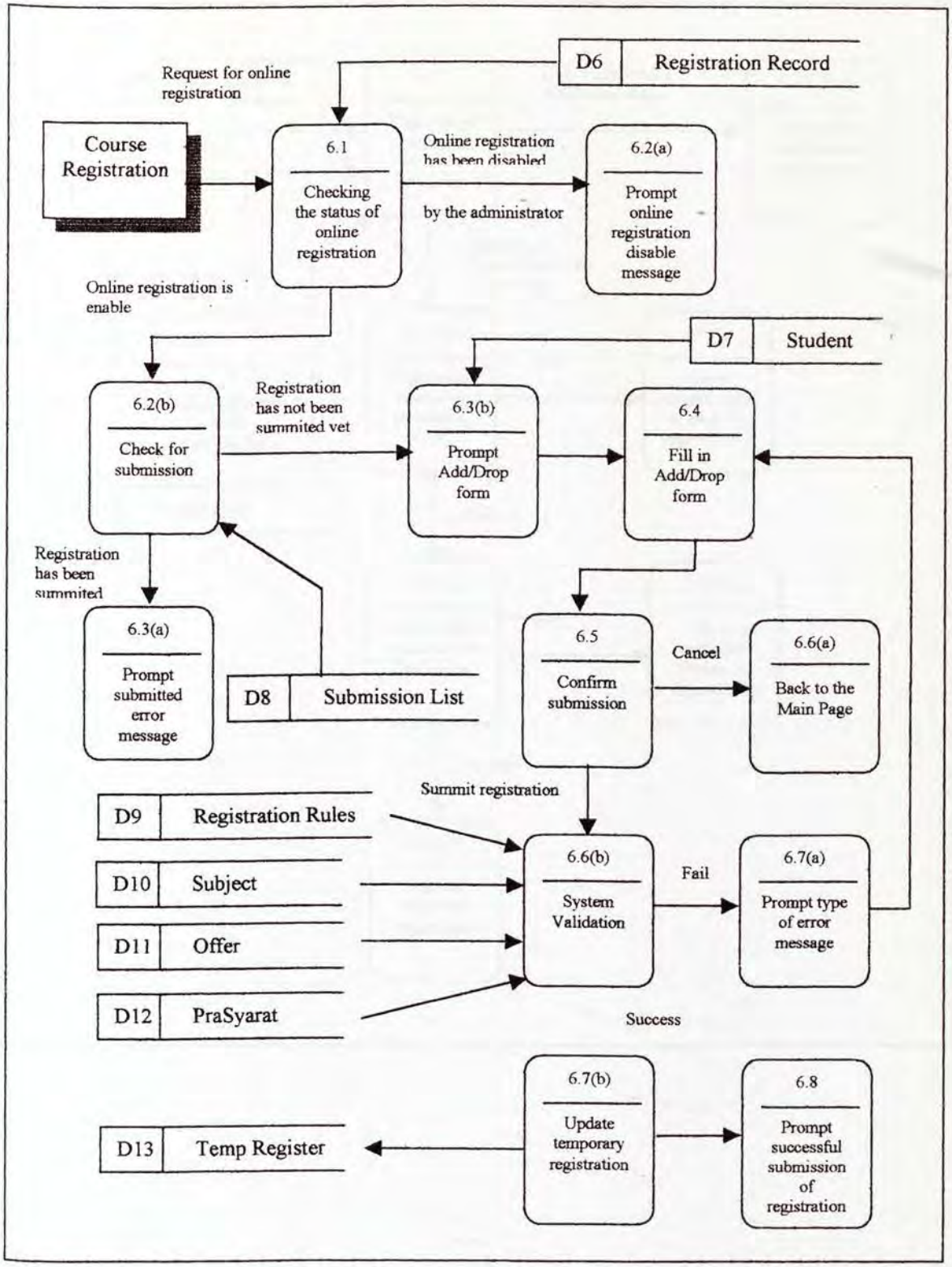
- Online Registration Module

Figure 4.14: DFD for Course Registration Module (For PPO1 form)



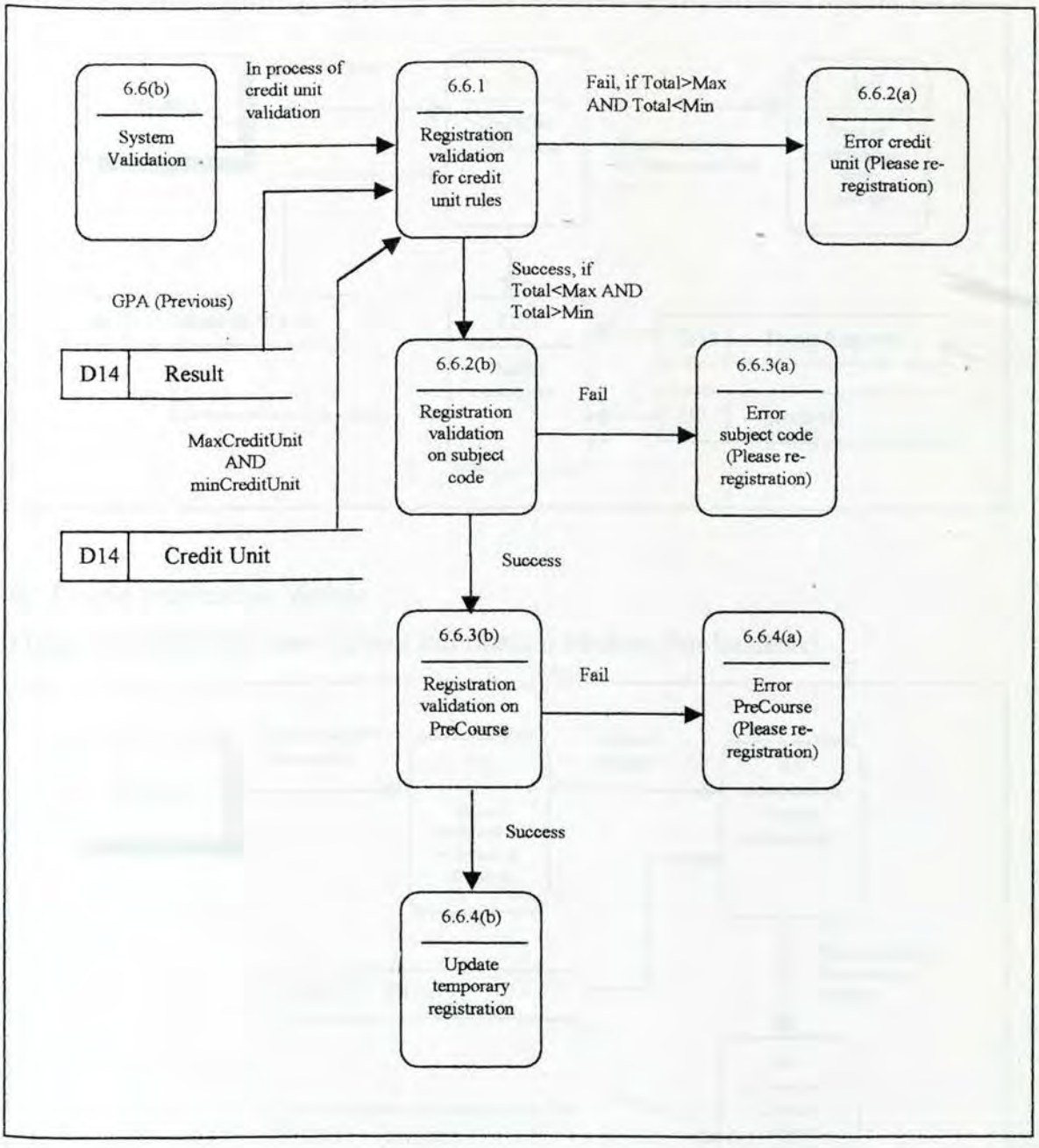
- Online Registration Module

Figure 4.15: DFD for Course Registration Module (For Add/Drop form)



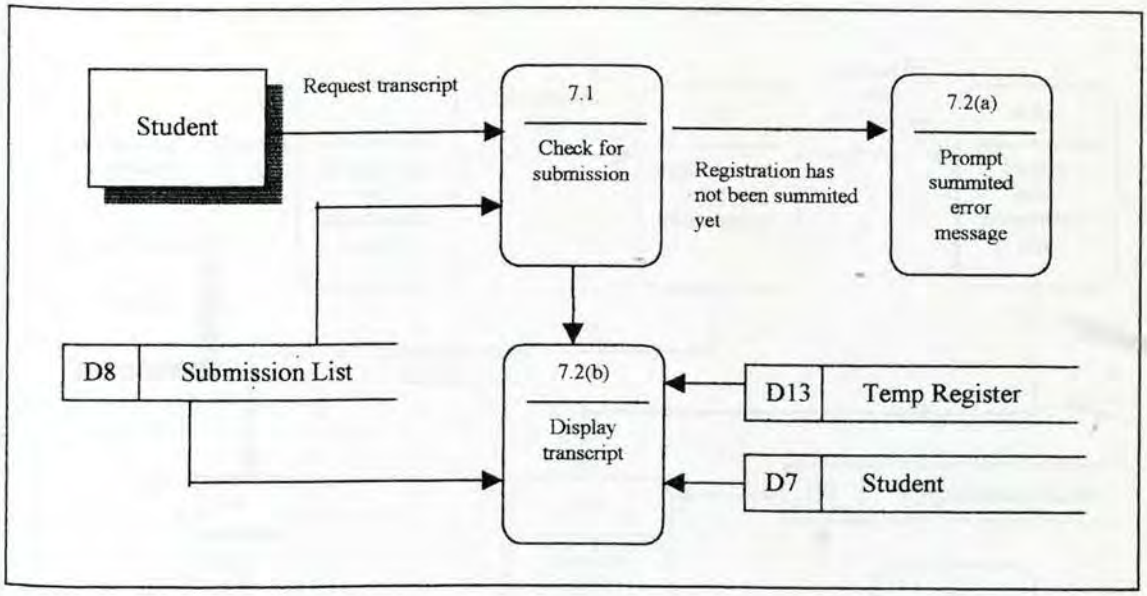
- Online Registration Module

Figure 4.16: DFD for the System Validation



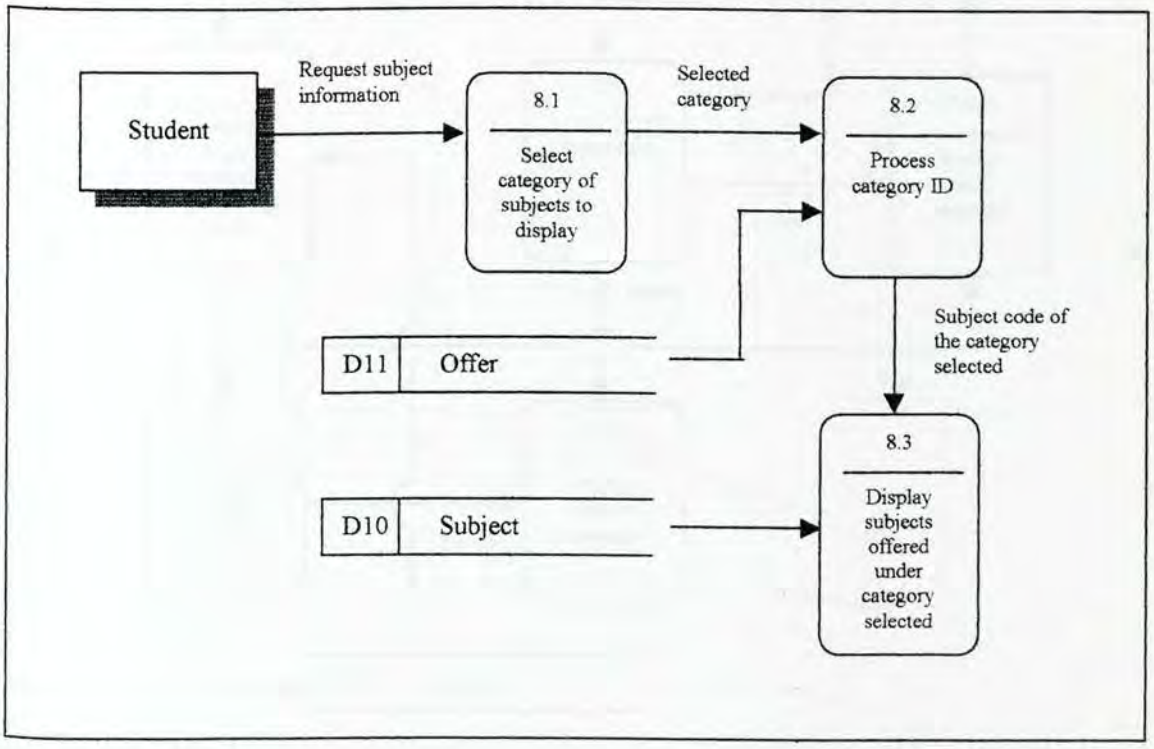
- Online Registration Module

Figure 4.17: DFD for Transcript Module



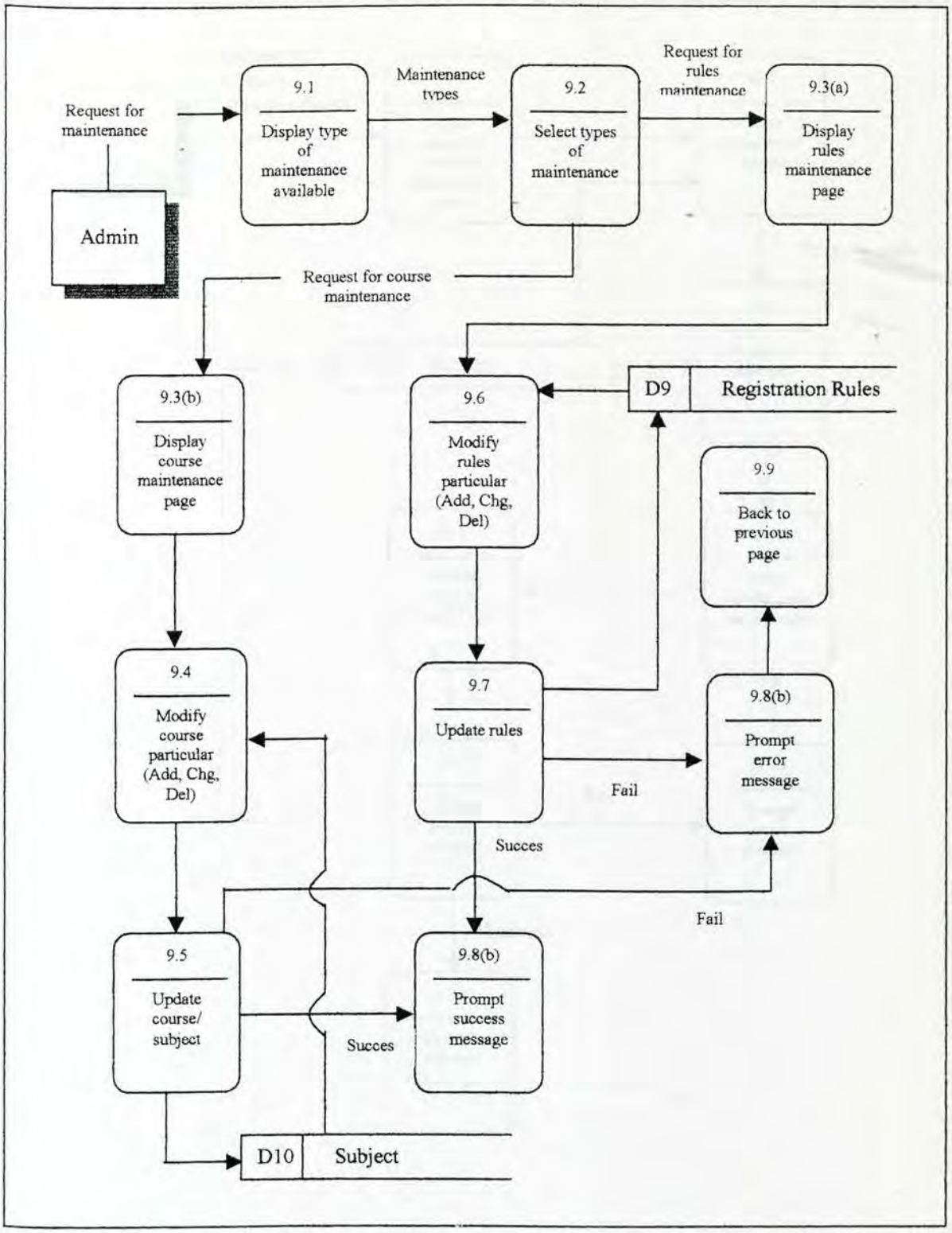
- Course Information Module

Figure 4.18: DFD for View Subject Information Module (For Students)



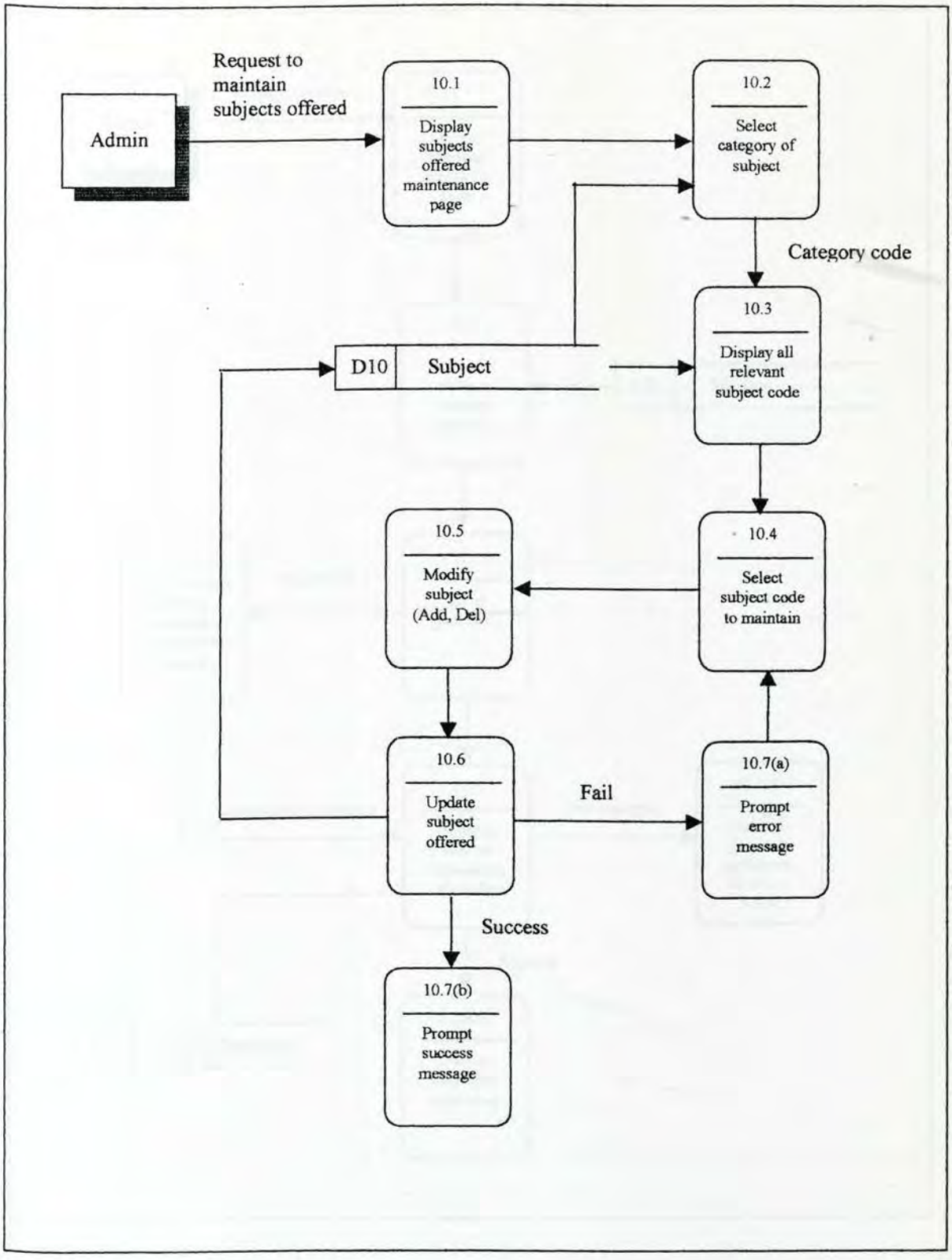
- Management Module

Figure 4.19: DFD for Course Maintenance and Rules Maintenance Module



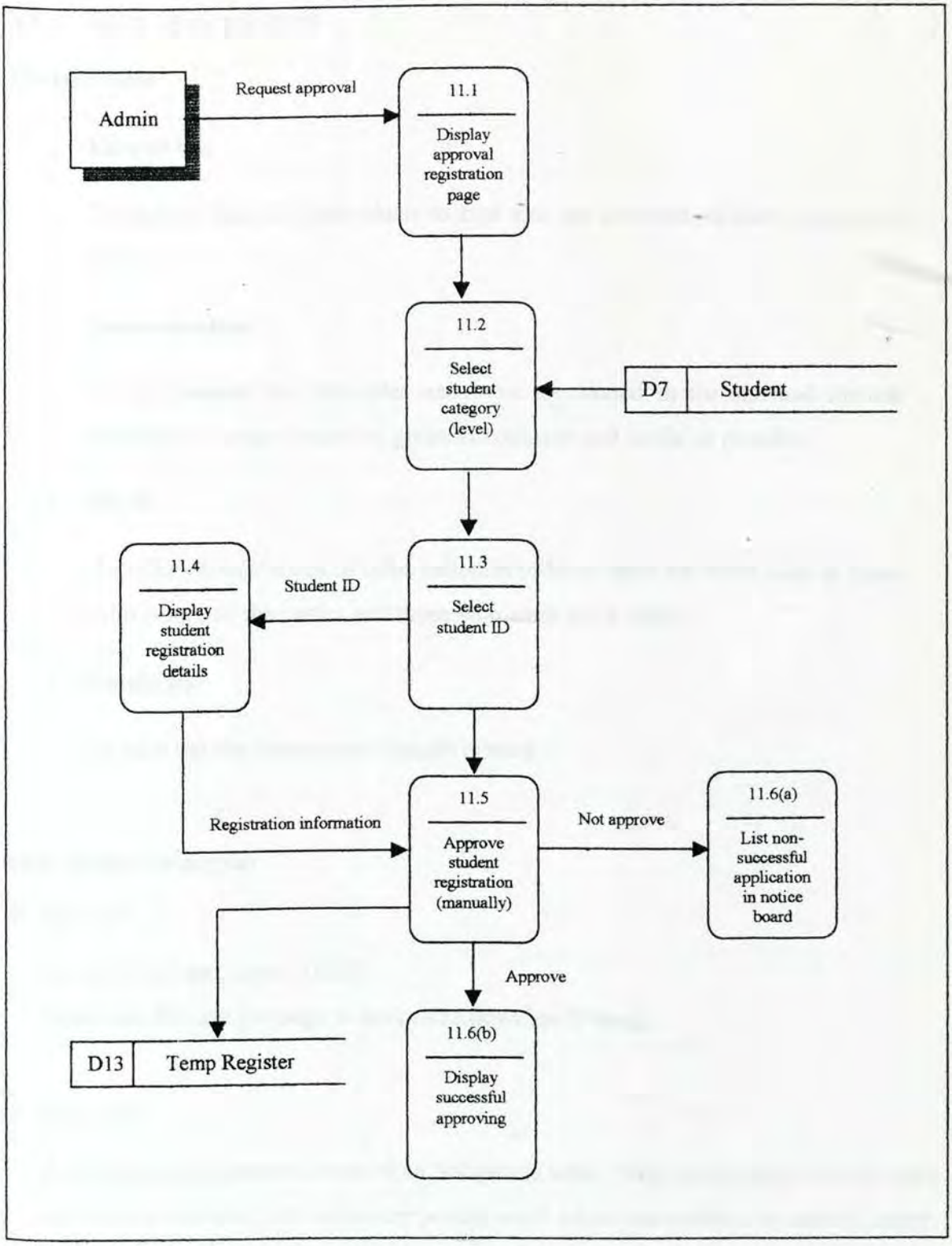
- Student Registration Management Module

Figure 4.20: DFD for Subject Offered Maintenance Module



- Student Registration Management Module

Figure 4.21: DFD for Approve Successful Registration Module



4.5 USER INTERFACE DESIGN

4.5.1 WEB SITE DESIGN

Design Goals

- **Ease of Use**

  To make it easy for individuals to find and use information that's relevant to them

- **Demonstration**

  To demonstrate the principles and tools mentioned in the site and include examples to make the advice given as concrete and useful as possible

- **Depth**

  To offer various levels of information in order to meet the needs both of those who want just the basics and those who want more detail

- **Simplicity**

  To keep the site simple and straightforward

Page Design Principles

❖ General

Keep it short and simple (KISS).
Minimize file size per page to maximize downloads speed.

❖ Page Size:

Avoid pages and graphics more than 500 pixels wide. (The default page size of some browsers is less than 500 and many people won't adjust the window to make it larger. Graphics that extend off the page are frustrating.)

Avoid pages and graphics that are more than two screens high. (People don't like scrolling and tend to lose interest. Also, if they want to print, shorter pages allow them to be more selective about what they print.)

- Text:

Minimize text. Divide text up so those pages don't look dense.
Avoid more than about 50 words or two lines in a paragraph. (Check out how the longer paragraphs above look)

- Text Styles:

Avoid italic because it's often hard to read and doesn't stand out.
Use boldface sparingly, or it loses its impact.
Use physical styles (plain, bold, italic, `teletype`) rather than logical styles (strong, emphasis, citation, `sample`, `keyboard`, `code`, variable) for greater control

- Formats:

Avoid the preformatted format unless it's really critically needed for emphasis
Don't use the address format because it is often hard to read or too small.
Neither the preformatted or address format can be used with HTML bullets

- Headings:

Use the largest heading style for the main heading on a page and other choices for subheadings.
Don't use headings for emphasis for text elements that are not headings

- Links:

Don't use too many links: only those that really enhance the page.
Integrate links into the text, and never say "Click here".

- Graphics:

  Keep graphics to a minimum file size to reduce downloading time

- Backgrounds:

  Make sure there's contrast between the background and text so that text is legible Avoid backgrounds that are bright or busy or detract from your content (unless you want that effect)

Chapter 5 System Implementation

The requirement analysis, system design and implementation phases do not have a clear boundary in a software project. Each phase tends to overlap one another. System implementation is a process that converts the system requirements and designs into program codes.

5.1 Development Environment

Development environment has certain impact on the development of a system. Using the suitable hardware and software will not only help to speed up the system development but also determine the success of the project. The hardware and software tools used to develop the entire system are as below:

Hardware Requirements

The hardware used to develop the system are as listed
266MHz Pentium Processor
64MB SDRAM
3.2GB Hard Disk
Other standard PC components

Software Requirements

Table 5.1: Summary of Software/Software tools Used

Software/Software Tools	Purpose	Description
Microsoft Windows NT Server 4.0 (Service Pack 4)	System requirement	Operating system (OS) [Final Stage]
Microsoft Windows 98	System requirement	Operating system (OS)

		[Earlier Stage]
Internet Information Server 4.0	System requirement	Web Server host [Final Stage]
Microsoft Personal Web Server (PWS)	System requirement	Web Server [Earlier Stage]
Internet Explorer 4.0	System development	Web browser
Microsoft® Notepad	System development	System file creation. Example: *.inc
Microsoft Visual InterDev 6.0	System development	Coding web pages
Microsoft Visual Basic 6.0	System development	Coding ActiveX components
Microsoft FrontPages 98	System development	Coding web pages and image design
Macromedia Dreamweaver 3.0	System development	Web pages layout design
Microsoft® Paint	System development	Image design and creation
Adobe Photo Shop 5.0	System development	Image design and creation
Microsoft SQL Server 7.0	System development	Database Server (Build the database to store and manipulate the data)
Microsoft Transaction Server	System development	ActiveX component registration

5.2 System Development

Methodology

SIS is developed using a modular approach where each module is developed separately and are integrated later into a fully functional system. For each module, it is further refined into functions and procedures. By using a modular approach, future modifications and enhancements are made easy.

Web Pages Coding

An Active Server Page (ASP) is primarily a scripting environment. Languages used to develop web pages using ASP technology are HTML, VBScript, JScript (by Microsoft) or JavaScript (by Sun). The challenge of coding in ASP is to determining and separating the HTML source code from the scripting counterpart.

There are two types of scripting which are client-side scripting and server-side scripting. For the client-side scripting, they must be delimited by the <SCRIPT>...</SCRIPT> tags. On the other hand, server-side scripting required the RUNAT attribute set to server so that the script will be executed on the server rather than the client (browser). Another easiest way for server-side scripting is using the script delimiters <% and %>. Any text enclosed within these delimiters will be processed as a script.

The process to develop web pages involves modification and testing of the ASP source code. It involves loading the file in the browser for viewing and validating and then going back to make further changes where necessary using any suitable web editor.

Web-Based Development Tools

Microsoft Visual InterDev 6.0 is used as the main development tool for this project. This tool enables easy performance of the many complex programming and database tasks required in the creation of the web sites, as well as the incorporation of the HTML formatting layouts, graphic and other multimedia components.

When working on a web sites with Visual InterDev 6.0 and performing tasks like adding to the site or editing any of the existing files, this tool creates a second copy of the files on the local computer. This is called the working copy. Whenever these working copies are saved, Visual InterDev 6.0 updated the file on the web server as well.

Graphics and the web pages layout are created and designed using Microsoft® Paint and Macromedia Dreamweaver 3.0 respectively.

5.3 Database Connection

The database for SIS is created using Microsoft SQL Server 7.0. By using Microsoft SQL Server 7.0, creating and modifying the tables, views and their relationship is made easy.

ActiveX Data Object (ADO) is used to store and retrieve data from a database. Before ADO can be used, a connection string has to be specified. It contains the driver name, data source, initial catalog, user id and password. All these information have to be specified in order to make a connection to the database.

All communication with a database takes place through an open connection. Before any information can be inserted into or retrieved from the database, a connection with the database must be opened. Using the Open method to open the connection and close the connection using the Close method.

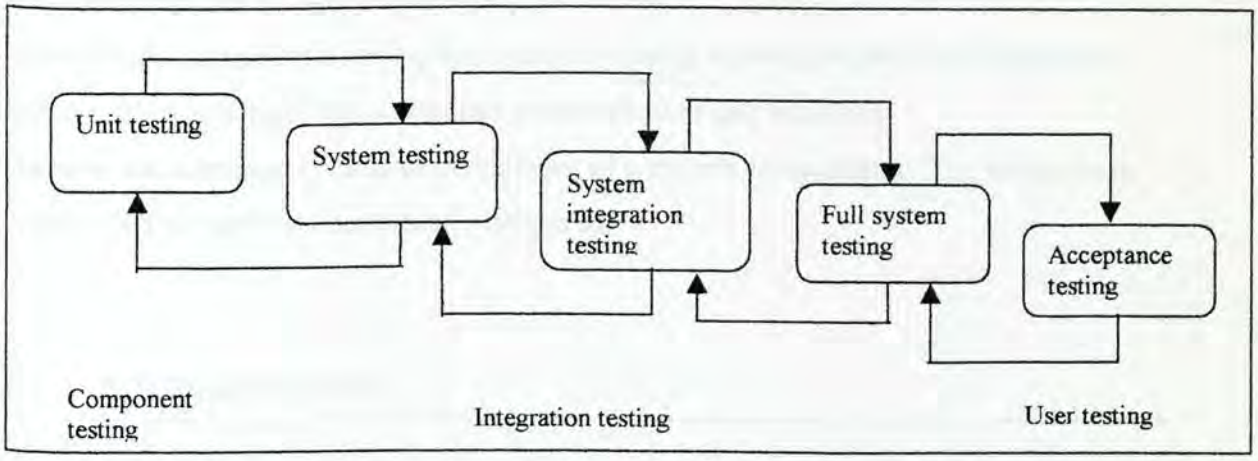
Chapter 6: System Testing

No matter how we write programs, it is obvious that from the variety of errors which are possible, we should check to ensure that our modules have functioned correctly. Testing is performed to ensure that the programs are executed correctly and to detect the existence of errors. It provides a method to correct logic error and for testing system reliability.

6.1 The Testing Process

Testing process for the SIS consists of five stages as shown in figure below:

Figure 6.1: The Testing Process



The sequence of testing activities is component testing, integration testing and then user testing. As defects are discovered at any stage, program modifications are required to correct them and this may require other stages in the testing process to be repeated. The process is therefore an iterative one with information being fed back from later stages to earlier parts of the process.

In Figure 6.1, the arrows from the top of the boxes indicate the normal sequence of testing. The arrows returning to the previous box indicate that previous testing stages may have to be repeated.

6.2 Testing Strategies

A testing strategy is a general approach to the testing process rather than a method of devising particular system or component tests.

The testing strategies include:

Top-down testing: testing starts with the most abstract component and works downwards.

Bottom-up testing: testing starts with the fundamental components and works upwards

Thread testing: is used for systems with multiple processes where the processing of transaction threads its way through these processes.

Stress testing: relies on stressing the system by going beyond its specified limits and hence testing how well the system can cope with overload situations

Back-to-back testing: is used when versions of a system are available. The systems are tested together and their outputs are compared.

6.3 SIS System Testing

For each module in SIS, they have been tested separately and were later being integrated together. After the integration, the system as a whole is test again. Each module contains functions and procedures that can be checked and tested carefully. These sub functions may call other sub functions and tests are carried to ensure all possible paths are tested.

Unit Testing

Unit testing verifies that the component functions properly with the types of input expected from studying the component's design. The first step is to examine the program code by reading through it, trying to spot algorithm, data and syntax faults. This is followed by comparing the code with specifications and with the design to make sure that all the relevant cases have been considered. Next, the browser is used to view the result, web pages and then eliminate remaining syntax faults if necessary. Finally, test cases are developed to show that the input is properly converted to the desired output.

For SIS, unit testing is done concurrently with the development phases. For example, the online course registration module has a sub-module which is to validate the registration upon submission by students. This sub-module is further divided to many functions such as capturing registration information, performing validation and presenting output or error messages. Each of these functions are reviewed and checked separately. Then the sub-module is tested to ensure it functions as desired. After all the sub-modules have been tested, the module will be inspected and tested as a whole.

Integration Testing

When the individual components are working correctly and meet the objectives and requirement, these components are combined into a working system. In other words, integration testing is the process of verifying that the system components work together as described in the system and program design specifications.

For SIS, a bottom-up approach has been used. Each module at the lowest level of the system hierarchy is tested individually. Then, the next module to be tested are those that called the previously tested module. This approach is followed repeatedly until all modules are included in the testing. Since SIS is developed modularly, errors found should be corrected in each module easily.

System Testing

The last testing procedure done is system testing. Testing the system is very different from unit and integration testing. The objective of unit and integration testing is to ensure that the code implemented the design properly. In system testing, a very different objective is to be achieved to ensure that the system does what the customer wants it to do.

Chapter 7: System Evaluation and Conclusion

7.1 Problems Encountered & Their Solutions

Research and studies in fields such as the Intranet, Internet and education system are the important stages in building this Intranet-based application. Besides that, a lot of system analysis has been done on technological and programming concepts to grasp the concept of Internet programming. The following are some of the major problems encountered from the beginning to the completion of the system development.

Difficulties in Choosing a Development Technology, Programming Language and Tools

There are many software tools available to develop a web-based database system currently as stated in the earlier chapters. Choosing a suitable technology and tool was a critical process as all tools have their strengths and weaknesses. In addition, the availability of the required tool for development was also a major consideration. A tough decision was needed to choose from Cold Fusion, Active Server Page technology, CGI or Java.

In order to solve this problem, seeking advises and views from project supervisor, coursemates and even seniors engaging in similar project were carried out. Further more, reading computer magazines especially PC Magazine Malaysia (Network Edition), surfing the Internet and visiting the library helped to clarify some doubts.

Operating System Installation

The operating system needed to run this project is Windows NT 4.0. However, Windows

98 was preinstalled in the computer that is used for system development. The problem here was the use of file system. Windows 95's file system is FAT 32. Windows NT 4.0 supports both FAT 32 and NTFS file system. So, there was a need to choose to format the selected system partition using NTFS/ FAT 32. As I was inexperienced in this area, it is one of the major problems that had been encountered during the system development process.

NTFS file system was recommended because it provides a significant security advantage. But NTFS does not allow reformatting back to current Windows 9x Operating system. FAT32 anyway allows this.

Next, is the version of service pack that available in the market. The newest and stable version and currently being using is Microsoft Windows NT Service Pack 4.0 1381. But for the earlier stage, I have borrowed the Microsoft Windows NT Service Pack 4.0 Build RC1.5 that failed the NT server services. After apply the wrong service pack, the Event Viewer prompt me "Unable to start some of the main services in NT because there is not enough storage to start them".

Handling New Operation System

As a new operating system to me, it took quite some time for me to learn the features in Windows NT and what it is capable of doing. The main problem I faced at the initial stage was the display colour. It was only 16 Colour and all the images displayed were awful. There were no other options in the Display Settings panel. To change the display colour to High Colour (16 bit) or True Colour (24 bit) as in Windows 95, I need a VGA driver that is compatible to Windows NT. The download copy has been downloaded from web by the search engines available on Internet. Meanwhile, others hardware components driver also needs to be downloaded from web. For example, printer. Furthermore, Microsoft Windows NT is quite sensitive to pirated software.

Determining Scope of the System

The fact that this project is actually a combination of the Internet & Intranet technology makes it difficult to build a full-scale and complete system within the give time frame. Inexperience with the current computerised system in web-based education system was another hindrance to implement true workable system. This if true since for the time being, no available Malaysia's education system is web-base. Even MahirNet just an intermediate agencies for education enrolment purposes. UNITAR is another university that offered a portion of this facilities.

Many discussions were held with project supervisor to outline the scope of the project to be built during the initial stages. After the scope has been defined, analysis of current computerised system was done in the system as stated in Chapter Three.

Inexperience in the Chosen Programming Language Vs Familiarity in Traditional Non-Web Based System

Previous knowledge in traditional, two-tier non web-based client server system does not seem to solve the lack in web-based system. Since there was no prior knowledge of programming in ASP and HTML, there was an uncertainty on how to organise the codes in a web page. These new programming languages and concepts were never taught before and to implement such an application requires a fair grasp of the language. Their programming approaches seem to be totally different from the traditional programming languages.

Although it really took time to learn the new technology, choosing to program in ASP proved to be a wise move. Most of the problems faced were manageable through surfing the Internet for related materials and referring to the reference books available in the market. Discussion with friends especially seniors using the same technology was a great help. A more efficient method was through trial and error during the coding phase.

Besides trying ASP, Cold Fusion and Lotus Notes also being tried and tested.

Executing SQL Statements within an ASP

To execute SQL statements within an ASP requires the Execute method. This method has two forms: One form is used when retrieving results from a database and the other form is used when no results are returned. It was a bit confusing at first. When executing a SQL INSERT statement where no results are returned, the Execute method doesn't use parentheses. An example is as below:

```
MyConn.Execute "INSERT MyTable (MyColumn) VALUES ('Hello!')"
```

However, the Execute() method can be used to return the results from a SQL SELECT query and parentheses must be included or else will get the error *Expected end of statement.* An example is as below:

```
Set RS = MyConn.ExecuteC'SELECT * FROM MyTable")
```

Besides that, the use of single and double quotes within the SQL statement adds to the confusion. An example is as below:

```
FOR index = 1 TO 5      ,
 MySQL = "INSERT MyTable (MyColumn) VALUES (' This is entry no. "&index&" ')"
NEXT
```

In order to solve this problem, hours are spent in trial and error during the coding phase.

Reference books do not give much information on this aspect. Summary of single and double quotes used within the SQL statement that I found out: Single quotes are used to

represent the quotation marks that appear within the SQL statement, double quotes specify the beginning and end of the string within VBScript.

Instability of Microsoft Components Product in Web-Based

A lots of Microsoft ActiveX components acts awful when it turns from traditional system to web-based system. Some of the properties, method and events in the components become undefined after integrate it in the web-based coding.

Readability Problem in ASP

Almost all web-based languages do not support for variety types of variable. It increases the writability for programmers but at the same time decrease the readability for them. Problems become more tedious when there are bugs detected in the program. Since the readability of the program is decreased then the code maintainability also decreased. It is very difficult to debug the errors especially semantics errors that are unable being detected by the debugger engine.

For example, listview.

To decrease the problem in this area, the more actions and testing must be taken if the components are chosen to be used to implement. Minimization in using the component is needed for a stable system.

Debugging Codes

Problems occurred when for debugging code in ASP. This is because ASP can be divided into two parts which are client and server side codes. Debugging for Server Side

Code is unavailable for Pre Installed Operating System which is Microsoft Windows 9x. Thus, it really takes time to determine which portion of code is miswritten when things are going wrong.

Using the Microsoft Script Debugger can solve these problems. It facilitates me when debugging program. IE would be automatically invoked and errors can be debugged easily. It is provided as options components from Microsoft NT Options Pack.

7.2 System Strengths

Friendly User Interface

The system has a friendly user interface that is easy to use. An authorized user is able to access all the functions in the system. GUI components such as command buttons, radio buttons, check boxes and drop-down list boxes are used to attract the users to navigate through the system. The learning curve is foreseen to be short and a user should be able to use the system with ease within minutes.

Easy Accessibility

This system is a web-based application and can be accessed easily using the Web browser. The Web browser needed especially Internet Explorer 4.0 which could be downloaded free from Microsoft's Web site.

Consistency User Interface and Available User Guidance

The interface is consistent in that comparable operations should be activated in this same way. For example, a message is rounded by a rectangle box and the LoginID section is

located at top of each page.

Enforce Different Access Level for Faculty Administrator

SIS also include the big module for administrators access level portion, which enable the management depends on the accessibility level determined by their respectively system administrators.

System administrators can determine the access level at run time and enforces the access level for their staffs.

Custom Password System

Creating a custom password-authentication system prevents unauthorized users from viewing pages that they don't have permission to access. More importantly, unauthorized users are prohibited from accessing records stored in the database.

Password Encrypted Site

The system has been secured by an encrypted technology provided through an encryption algorithm. The DES, a systemic encryption algorithm has been chosen to implement in SIS.

Reliable System with Effective Error Recovery

This is a reliable system as it caters for almost any possible errors encountered. Server-side scripting will generate appropriate feedback to user when error occurs. For example,

a password validation failure or a user login ID failure is handled by the system and a user-friendly message is generated informing the user about the type of error.

Transaction is used in this system because there is a need to update information in more than one table but don't want one update to fail and the other to succeed. The BeginTrans and CommitTrans methods are used to mark the beginning and end of a transaction. After the BeginTrans method call, if anything goes wrong before CommitTrans is called, the tables are not updated. If the system is down after the first table is updated, this change is automatically rolled back. The purpose here is to ensure data consistency in the database.

Relatively Fast Response Time for Document Retrieval

The Web pages are designed in such a manner that they are loaded in a reasonable amount of time to ensure users need not wait too long to view the pages. Heavy graphics are avoided and ActiveX controls are kept to the minimum wherever possible.

7.3 System Limitations

Platform

This system is limited to certain platforms in terms of openness. It supports Windows 95, Windows 98, Windows NT and Internet Explorer 4.0 or above. This limitation is due to the usage of ActiveX controls and VBScript in the system, which is not recognized by other browsers such as Netscape.

Browser's Cache Information

The web browser normally maintains a cache of web pages that a user has visited before

on his local computer. If there are multiple users using the same computer, and all of the users share the same cache directory, then confidential data that is cached may be exposed to unauthorised users. To ensure confidentiality, the user has to clear the cache on his computer each time he leaves his or her own computer unguarded.

7.4 Future Enhancements

Support Other Browsers

As stated, this system requires Microsoft Internet Explorer 4.0 and above for execution. In future, it can be tuned to fulfil other browser requirements such as Netscape Communicator for execution. This is because Netscape has a sizeable share in the browser market besides Internet Explorer.

Language Support

Future enhancement for the Extranet system will include language support. This will enable information to be displayed in different languages like Japanese, Chinese, Tamil and others. This will broaden the usage of the system, as the system will come from different countries with different national languages.

Error Detection Features

This system actually needs a more comprehensive error detection feature to ensure that only valid input is being passed to the server and it is done through client-side scripting. This is important in ensuring that the Intranet system is robust and easy to maintain the reliability of the system.

7.5 Conclusion

Overall, SIS has achieved and fulfilled the objectives and requirements as a web-based student information system that provides facilities in online course registration system and others.

A lot of knowledge was gained throughout the development of the system. These include knowledge in setting up NT Server, Internet technologies, programming and concepts as welt as using SQL Server. Programming in ASP, HTML, VBScript and JScript proved to be a valuable experience. ASP technology although new has captured the attention of many software and web developers. It provides very powerful features enabling one to create highly interactive and dynamic Web pages. The core of the ASP technology lies in the implementation of object-oriented technology. As such, the object-oriented programming skill has improved tremendously. The tedious and difficult handling education structure and business rules is a challenge where help to improve patient and increase the level of logical thinking.

Finally, all the problems faced and experiences gained during the system development should be useful in the future endeavors. This is because the era is now moving towards Internet technology that requires decent knowledge in Internet programming including the knowledge in deploying the network systems and functionality.

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ACRONYMS

ADO	Active Data Objects
API	Application Program Interface
ASP	Active Server Page
CFML	ColdFusion Markup Language
CGI	common Gateway Interface
DFD	Data Flow Diagram
FSKTM	Faculty of Computer Science and Information Technology
GUI	Graphic User Interface
HTML	Hyper Text Markup Language
IIS	Internet Information Server
IS	Information System
ISP	Internet Service Provider
LAN	Local Area Network
MMC	Microsoft Management Console
NIC	Network Interface Card
ODBC	Open Database Connectivity
OLAP	Online Analytical Processing
OOP	Object Oriented Programming
PERL	Practical Extraction and Report Language
PL/SQL	Procedural Language/Structure Query Language
PWS	Personal Web Server
RDO	Remote Data Objects
SEED	Smart Extended Education
SIS	Student Information System
SQL	Structure Query Language
TCP/IP	Terminal Control Program/Internet Protocol
UKM	University Kebangsaan Malaysia
UM	University Malaya
UPM	University Putra Malaysia
USM	University Sains Malaysia
UNITAR	University of Tun Abdul Razak
WAN	Wide Area Network
WWW	World Wide Web

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CHAPTER 1: INTRODUCTION

1.1 Welcome

This document is the User Manual for Student Information System (Online Course Registration System) for the Faculty of Computer Science and Information Technology (FSKTM). It is build with reference to University of Malaya and FSKTM structure and rules and regulation.

Student Information System (SIS) is designed to make it a reality for the FSKTM to have an e-faculty status. This system is actually design for students to let them perform courses registration online. SIS also includes administrator's section, which enable them to configure the system and monitor students' registration process.

SIS is easy to use, all the functions in this system is meaningfully descriptive and can easily be executed by a simple point and click on the available function button and hypertext link.

1.2 About this manual

This user manual will guide you through all the function available in the system. This manual includes the following parts:

- Administrator section guides
- Student section guides

1.3 Conventions

To help you locate and interpret information easily, this user manual uses consistent typographic. Those conventions are explained as follows:

	Represent
Italic	Anything that must be type in exactly as it appears or refers to the terms use in the system. For example, if you are required to type
<>	Standard button for user clicking
Navigation | Option	Indicate linkage to other pages

1.4 Standard Coding

For this system, there are some data which are fixed and not allow to modify by anyone including administrators who monitor the system. Those data are listed in the table below.

Subject	Code	Description
Access Level	STU	Student
	LEC	Lecturer
	ADM	Administrator
	GOF	General Officer

Department	SE	Software Engineering
	AI	Artificial Intelligent
	NT	Networking
	MIS	Management Information System
	SM	Sumber Maklumat (IT)
	P	Management (IT)
	M	Multimedia (IT)
	NONE	No Department
	ALL	All Department
Faculty	FSKTM	Faculty of Computer Science and Information Technology
	ALL	All Faculties
Course Category	U	University Course
	FE	Elective Course (Faculty)
	FC	Compulsory Course (Faculty)
	DE	Elective Course (Department)
	DC	Compulsory Course (Department)
	E	Elective Course (Outside)
	M	Minor Course

CHAPTER 2: HARDWARE AND SOFTWARE REQUIREMENTS

2.1 Hardware Requirements

Server:

Min Intel Pentium 266 MHz

Min 64 MB RAM

Hard disk - depended on volume of transactions

Network Interface Card (NIC)

A SVGA Graphics Adapter

Keyboard and Mouse as input devices

Workstation:

Standard PC which support online which included modem and NIC

A SVGA Graphics Adapter

2.2 Software Requirements

Server:

Microsoft Windows NT Server 4.0, required Service Pack four or above

Microsoft Internet Information Server (IIS)

Microsoft Transaction Server (MTS)

Microsoft SQL Server (SQL)

Workstation:

Windows 95 or Windows NT Workstation

Microsoft Internet Explorer 4.0 or above

CHAPTER 3: ADMINISTRATORS SECTION

The following section will describe all the functions in SIS. This administrator section will be run on Local Area Network (LAN) using Visual basic application. But before accessing this application, make sure that your computer meets the minimum hardware and software requirement as stated in the previous chapter.

Administrator section has four modules which are Configuration module, Course module, Rules module and Student Registration module. Each of the modules has its functions or procedures which play their own part respectively. Figure 3.1 shows the main pages of the system.

Before the administrators are allow to use the system, he or she is require to login as a valid user. The system will limit the user access level base on the login identification. For example, the valid user is allowed to use the Course module and Student Registration module but not allowed to use the Configuration module and Rules module. Figure 3.2 shows the pages after the user had successfully login as a valid user.

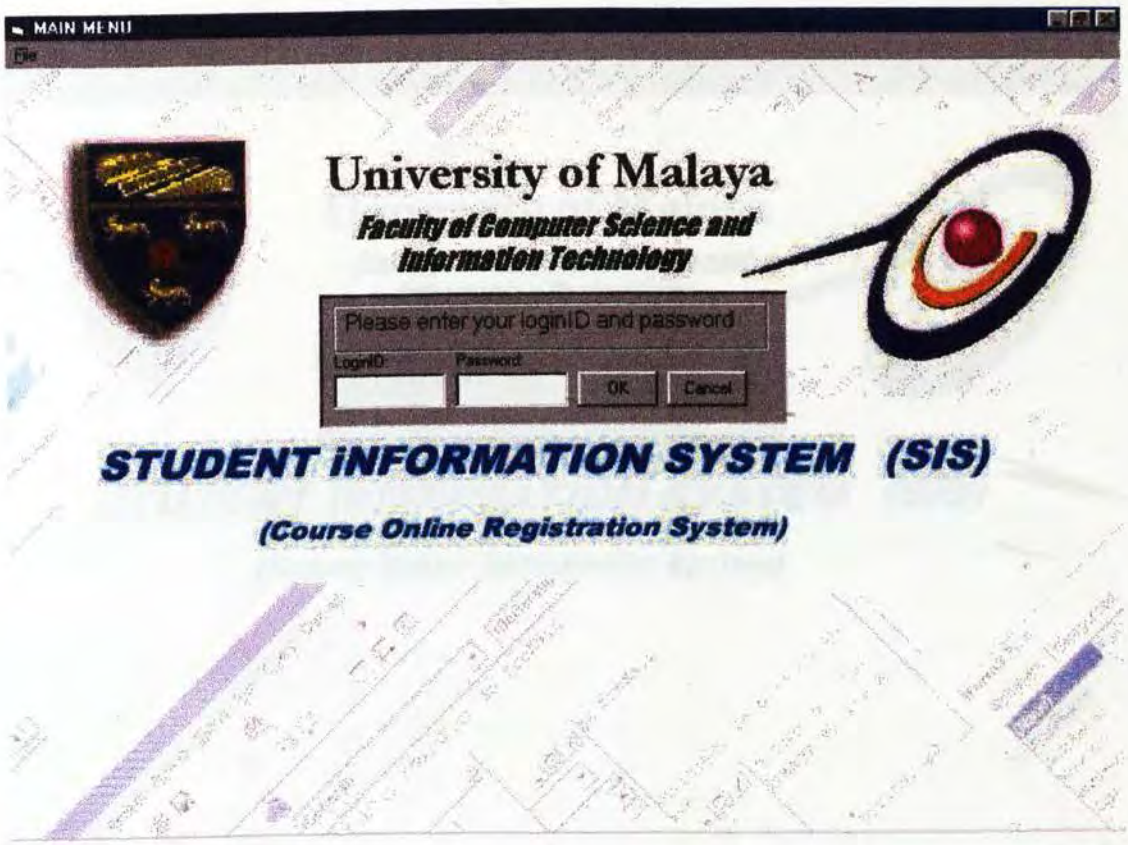

Figure 3.1 Main Page (Before login)

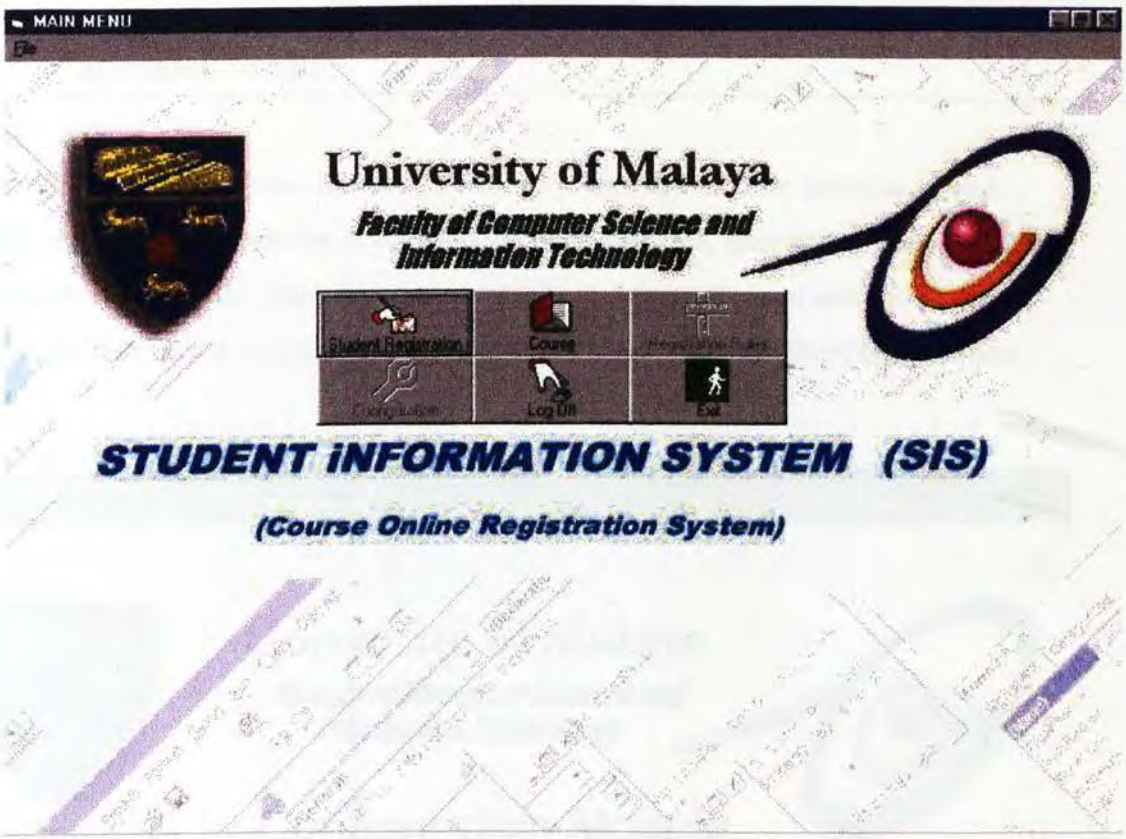

Figure 3.2 Main Page (After login)

3.1 Configuration Module

Configuration module consists of seven functions which are module function, menu function, module-menu function, level function, user function, user access function and change password function. Each function generally has three types of actions which are Add, Change and Delete mode. Figure 3.3 shows the main page for the Configuration module.

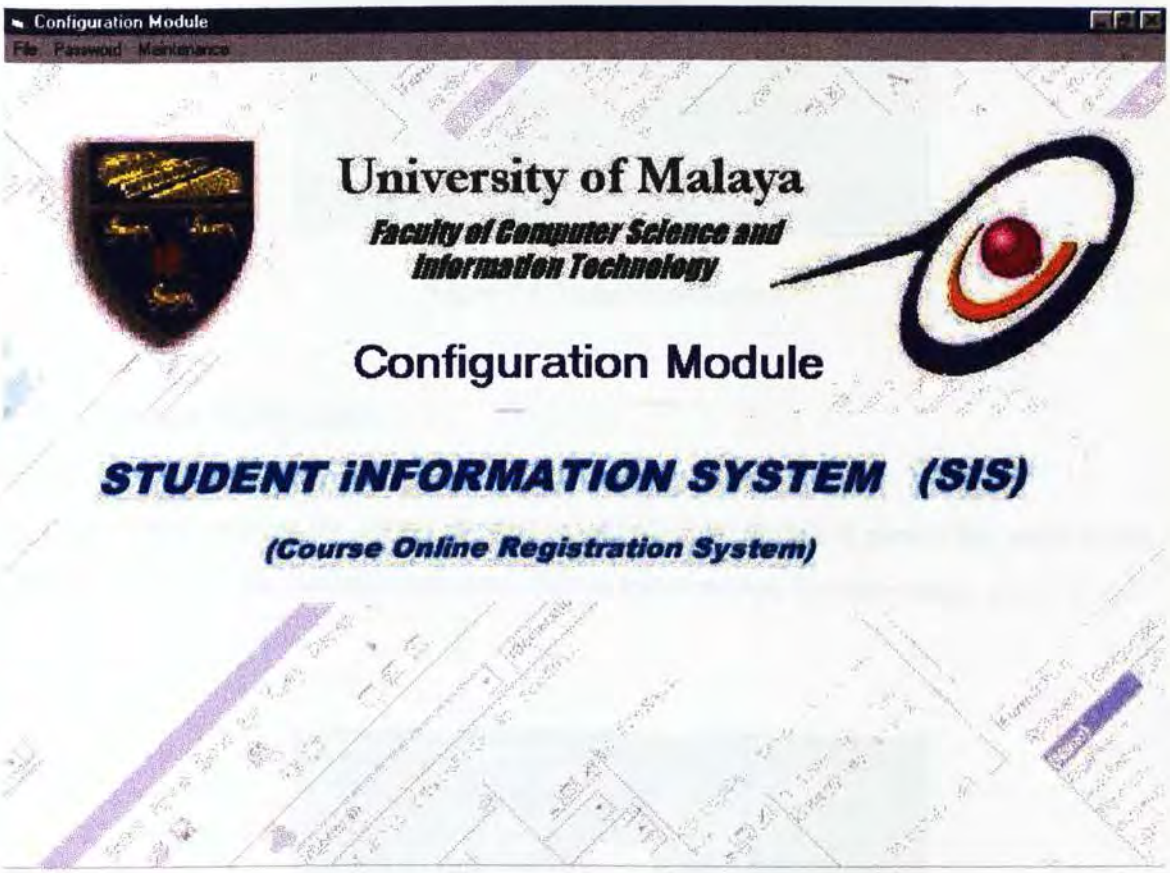

Figure 3.3 Configuration Module Main Page

3.1.1 Module Maintenance

This function enables the administrators to add, change or delete modules that exist in the system. There are four main modules in the system which are Configuration, Course, Rules and Student registration module.

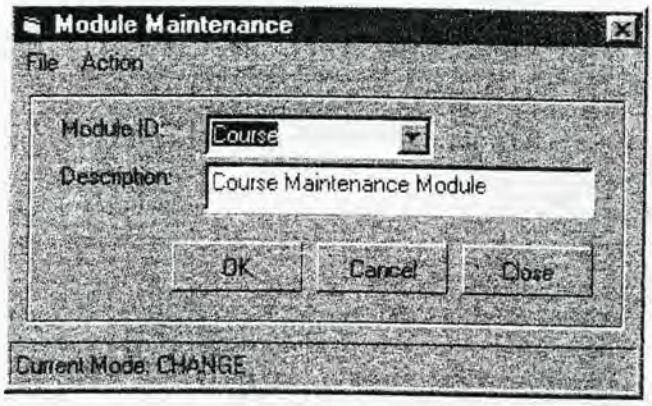

Figure 3.4: Module Maintenance

3.1.2 Menu Maintenance

This function enables the administrators to add, change or delete menus that exist in the system. Each of the modules may have one or more menus. In other word, menu is sub-module.

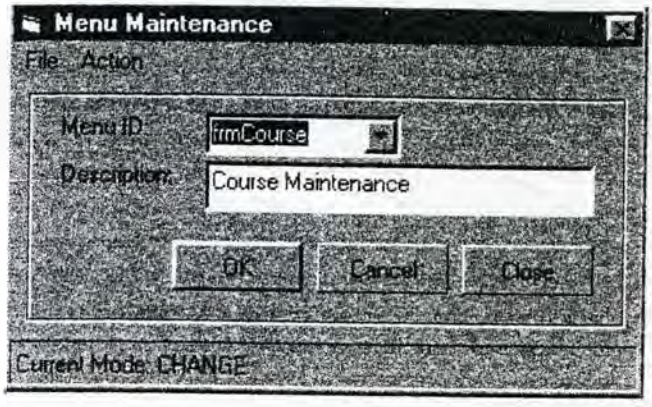

Figure 3.5: Menu Maintenance

3.1.3 Module-Menu Maintenance

This function enables the administrators to assign menus to the modules by checking the check box that have been provided. It has only one mode which is modify mode. The <Re-Generate> button is uses to re-bind the module and menu whenever any new module or menu is added into the system.

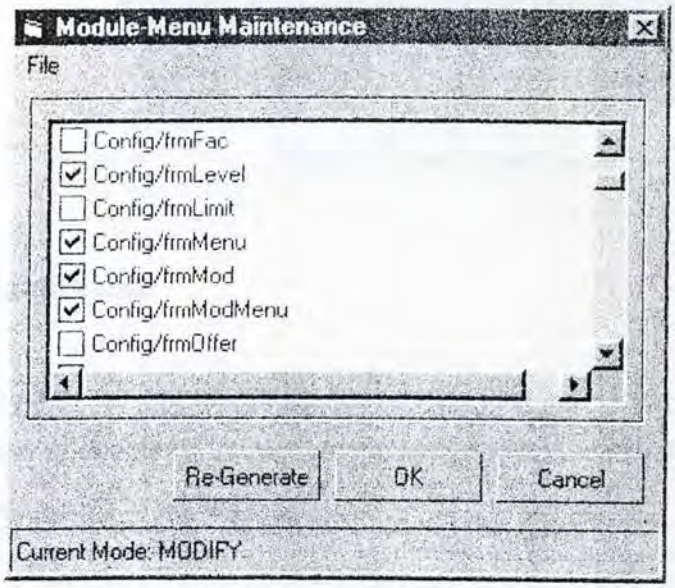

Figure 3.6: Module-Menu Maintenance

3.1.4 Level Maintenance

This function enables the administrators to add, change or delete level that exist in the system. It has four levels which are student level, administrator level, lecturer level and general officer level.

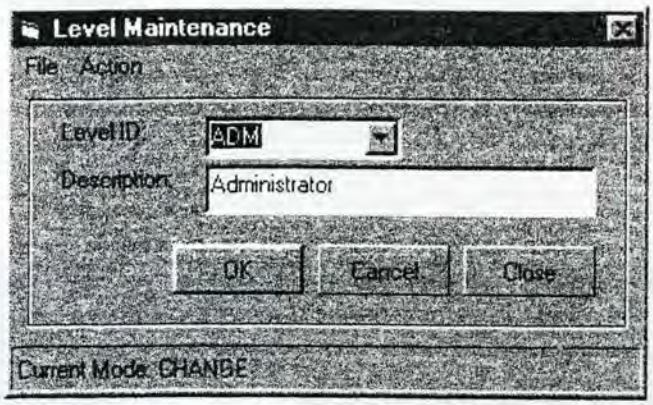

Figure 3.7: Level Maintenance

3.1.5 User Maintenance

This function enables the administrators to add new user and change or delete existing user in the system. It enables administrator to assign level identification to the user and change or add password to the user.

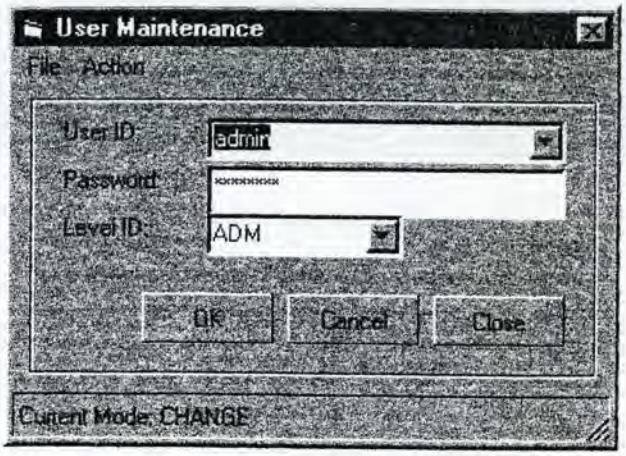

Figure 3.8: User Maintenance

3.1.6 User Access Maintenance

This function enables the administrators to assign the module and menu to the user in the system. It defines the user accessibility in the system.

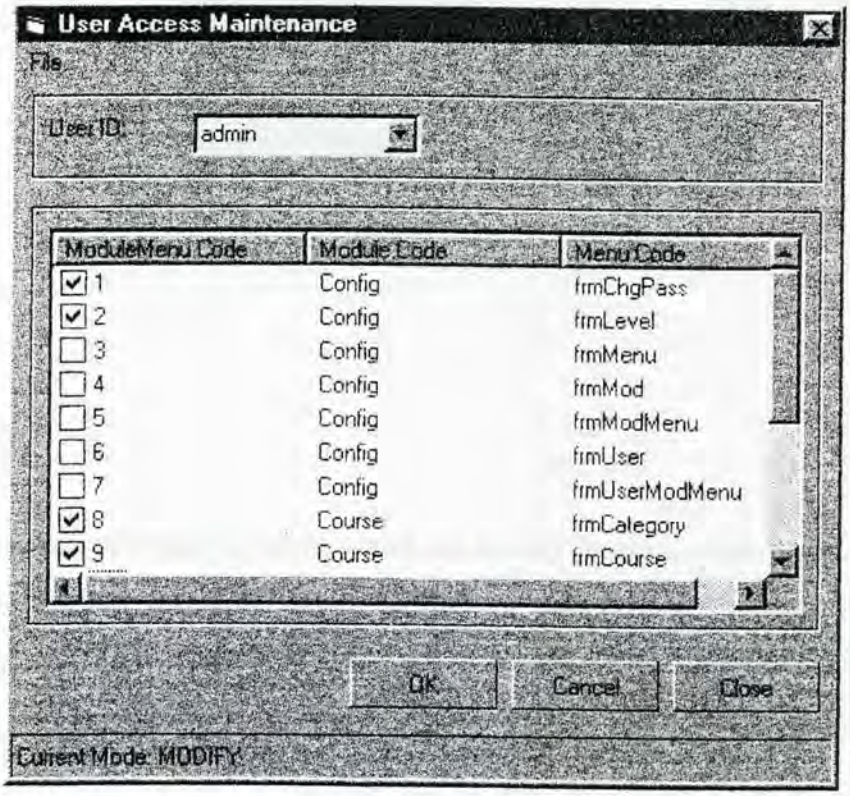

Figure 3.9: User Access Maintenance

3.1.7 Change Password

This function enables the administrators to change their password. It requires the user to type in their old password and new password. The new password has to be re-type in order to confirm that the new password is typed correctly.

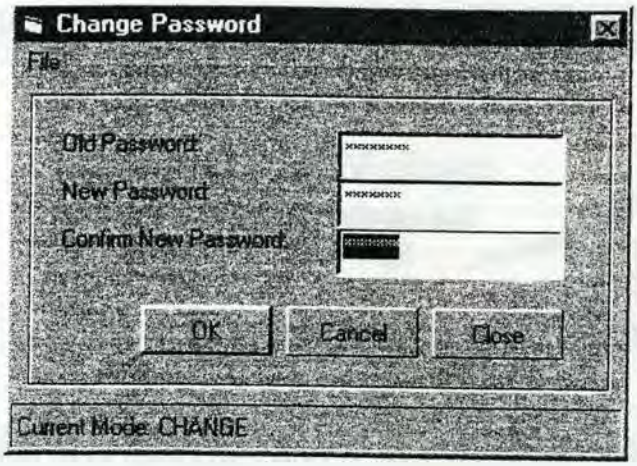

Figure 3.10: Change Password

3.2 Course Module

Course module consists of seven functions which are faculty function, department function, category function, course function, prerequisite function, offer function and limit function. Each function generally has three types of actions which are Add, Change and Delete mode. Figure 3.11 shows the main page for the Course module.

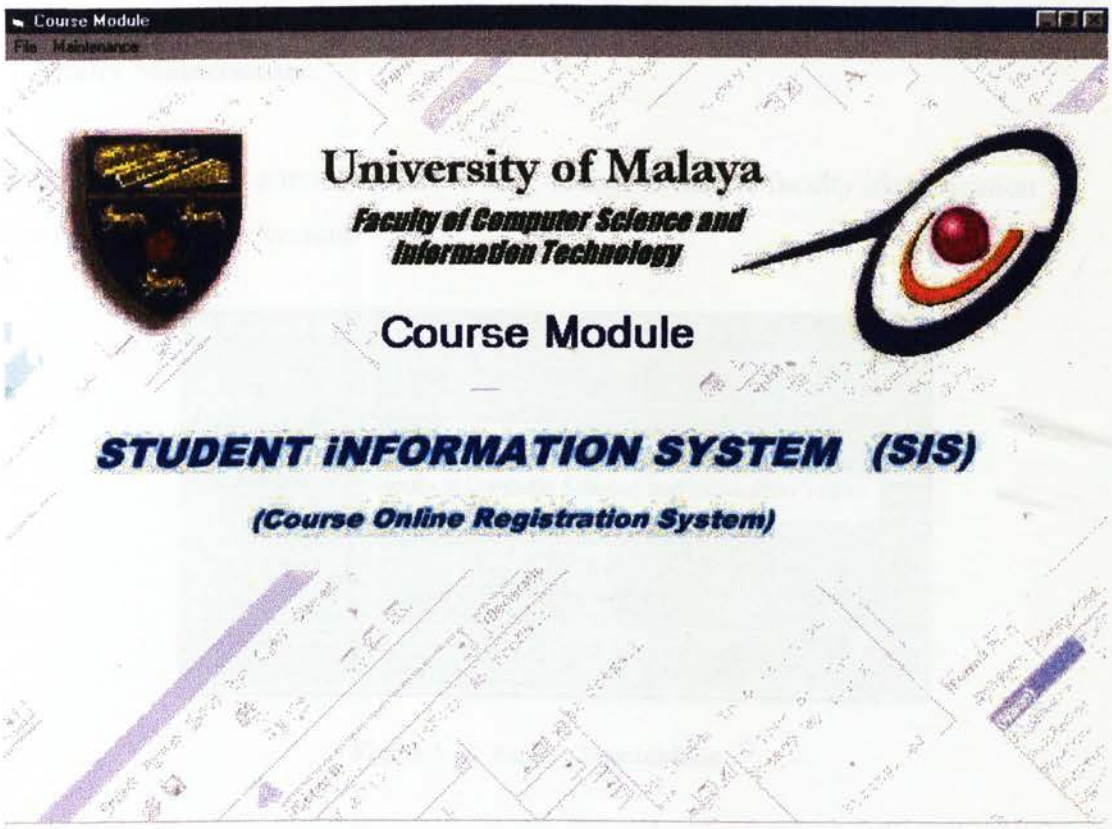

Figure 3.11: Course Module Main Page

3.2.1 Faculty Maintenance

This function enables the administrators to add, change or delete faculty identification and name that exist in the system.

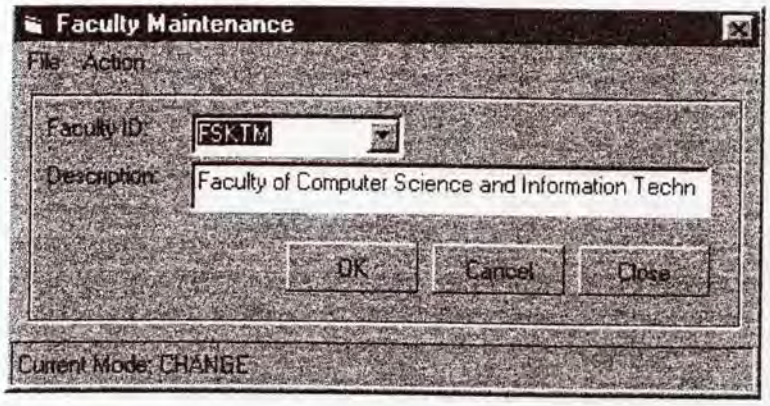

Figure 3.12: Faculty Maintenance

3.2.2 Department Maintenance

This function enables the administrators to add, change or delete department identification and name that exist in the system.

Figure 3.13: Department Maintenance

3.2.3 Category Maintenance

This function enables the administrators to add, change or delete category identification and name that exist in the system.

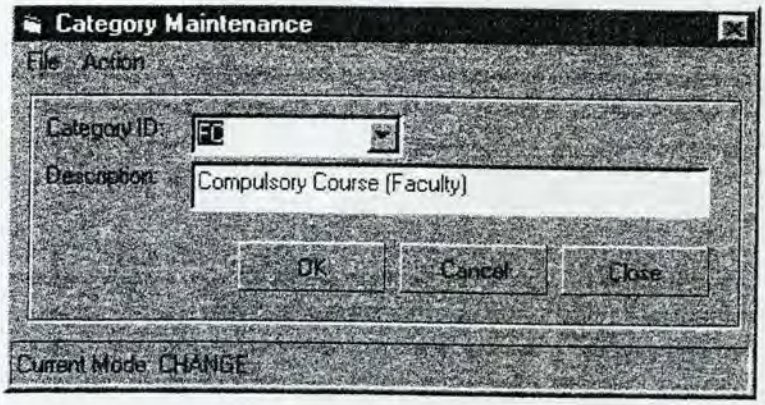

Figure 3.14: Category Maintenance

3.2.4 Course Maintenance

This function enables the administrators to add, change or delete course information in the system. This is the one of the main functions of the system. It required user to enter faculty id, department id, category id, name and credit hour for the course. If the course is offer for every faculty, then enter value, *ALL* as its faculty id. It also required information such as prerequisite, level, semester and countGPA. If the result of the course will be counted into the final result, then choose the *YES* option else choose *NO*.

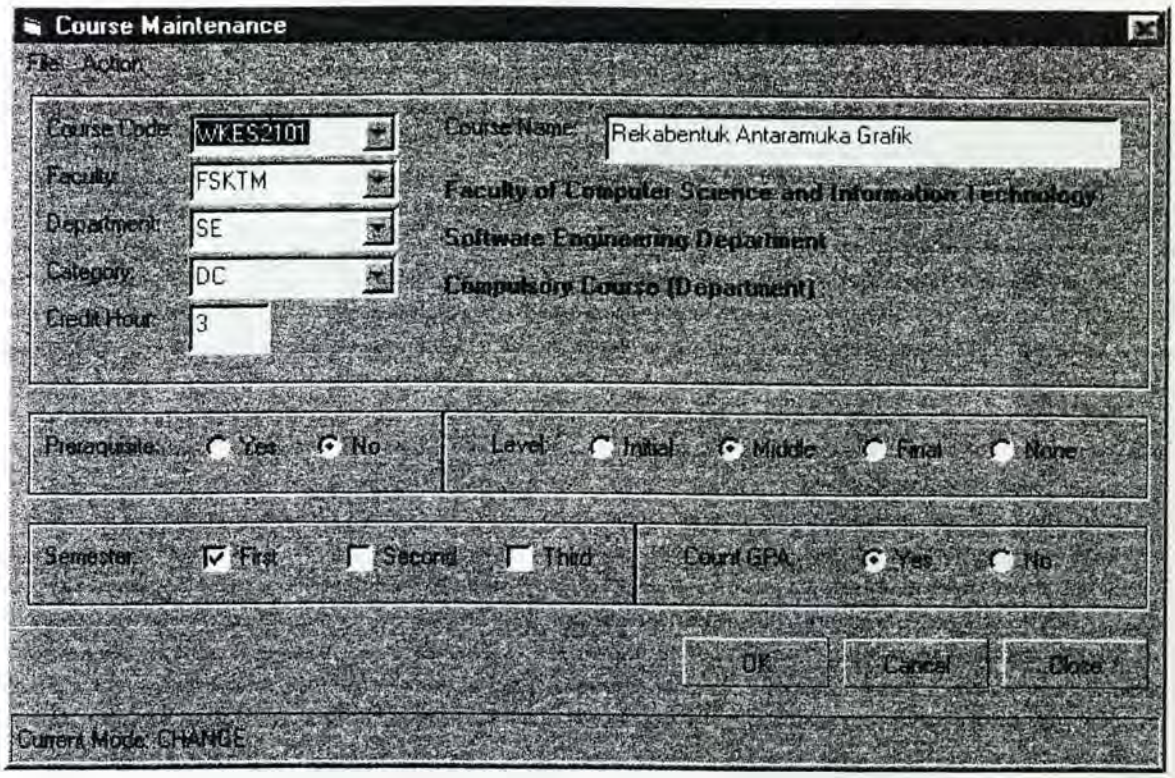

Figure 3.15: Course Maintenance

3.2.5 Prerequisite Maintenance

This function enables the administrators to assign prerequisite course to the course that required pre-course(s) as in the previous screen that the prerequisite value is set to *YES*.

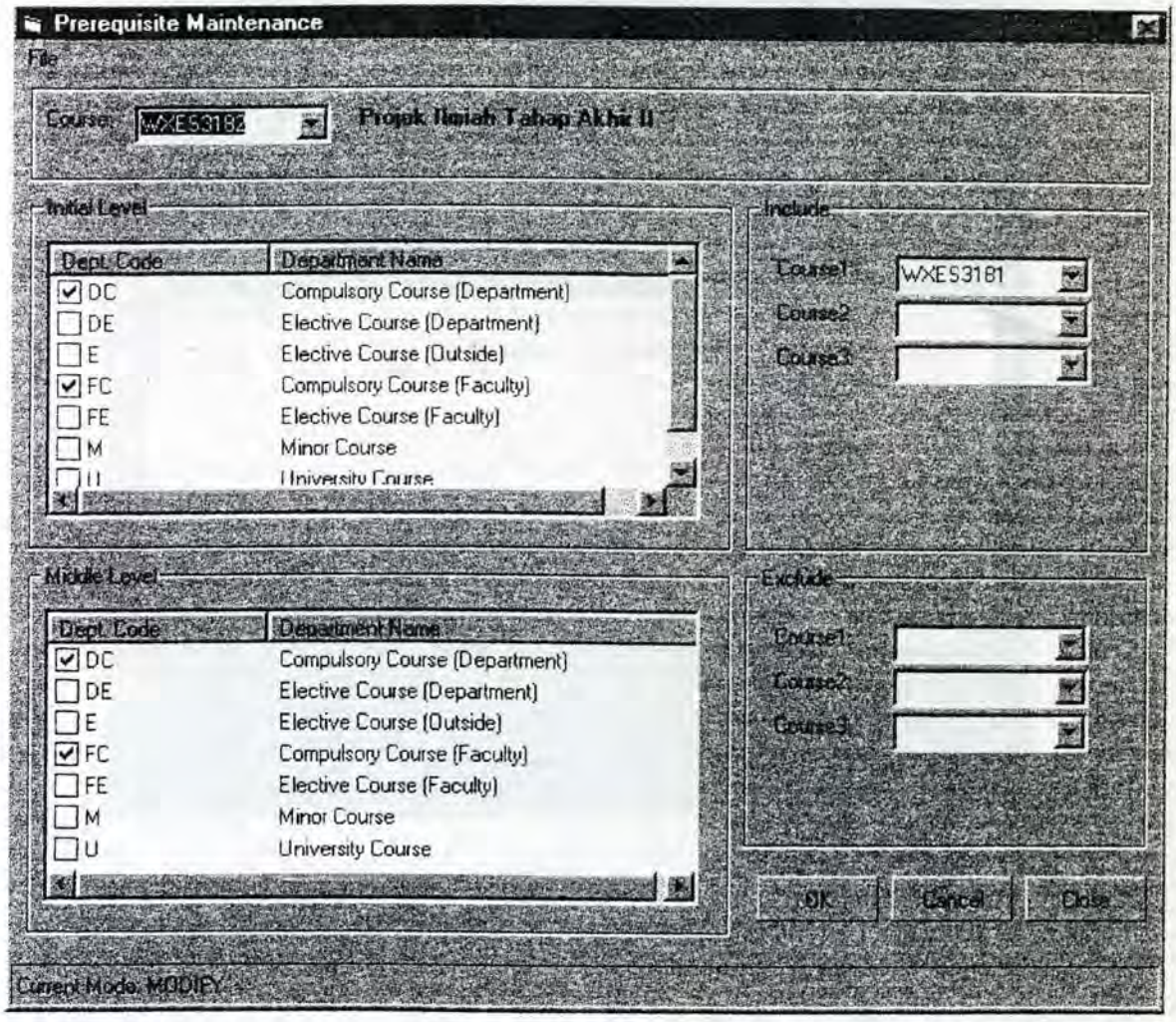

Figure 3.16: Prerequisite Maintenance

3.2.6 Offer Maintenance

This function enables the administrators to assign a course whether it is offer or not for the current semester by checking the check boxes. Users also have to specific the faculty id, department id and level id before click the <Load> button to load or retrieve the information.

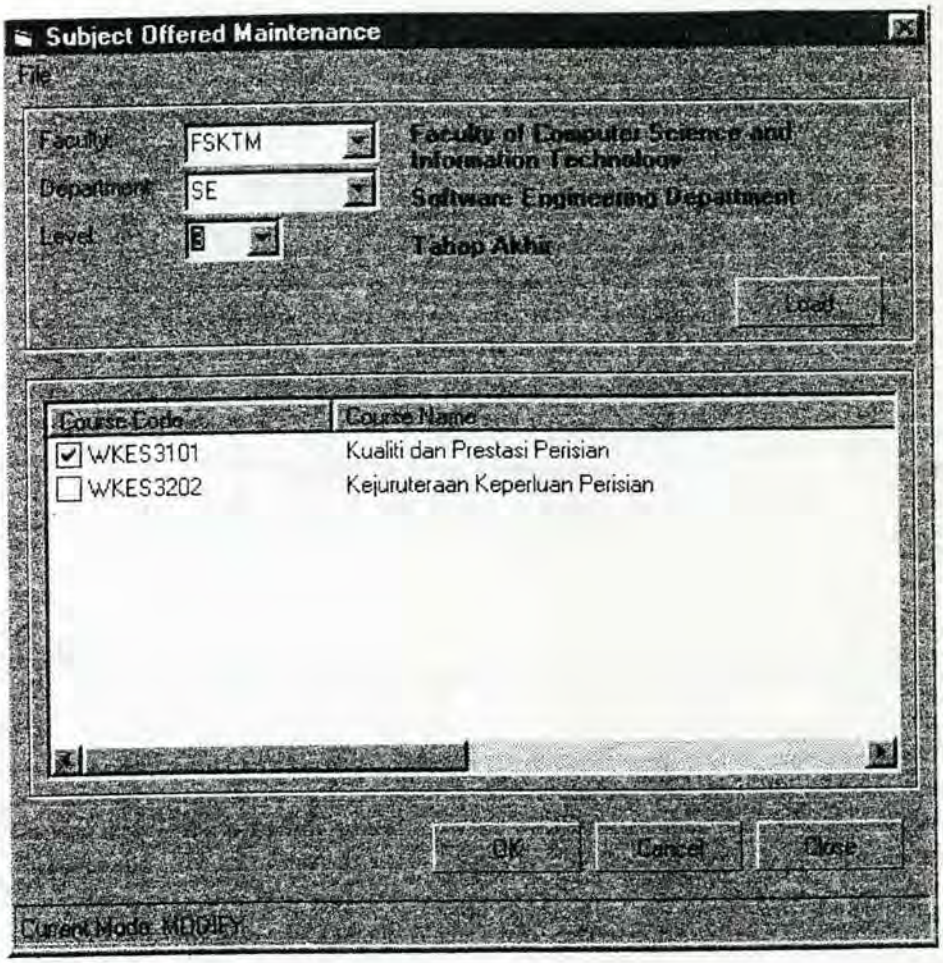

Figure 3.17: Offer Maintenance

3.2.7 Limit Maintenance

This function enables the administrators to set the course enrollment limit for the current semester. By clicking the <Default> button, the enrollment limit for all the courses will be set to 1000 by default.

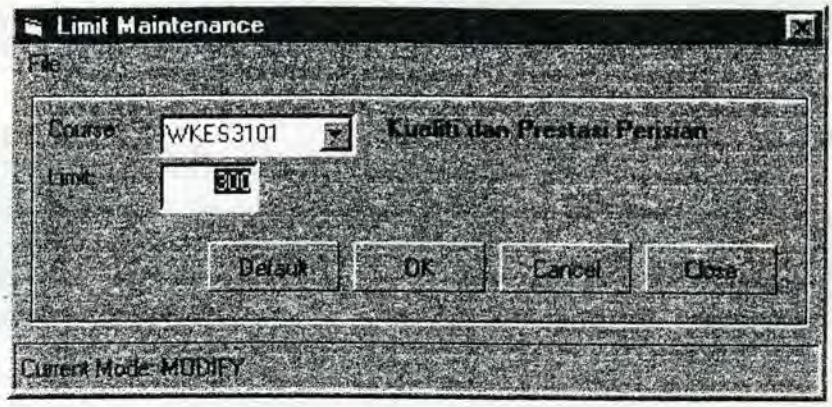

Figure 3.18: Limit Maintenance

3.3 Rules Module

Rules module consists of two functions which are credit hour function and submission function. Each function generally has three types of actions which are Add, Change and Delete mode. Figure 3.19 shows the main page for the Rules module.

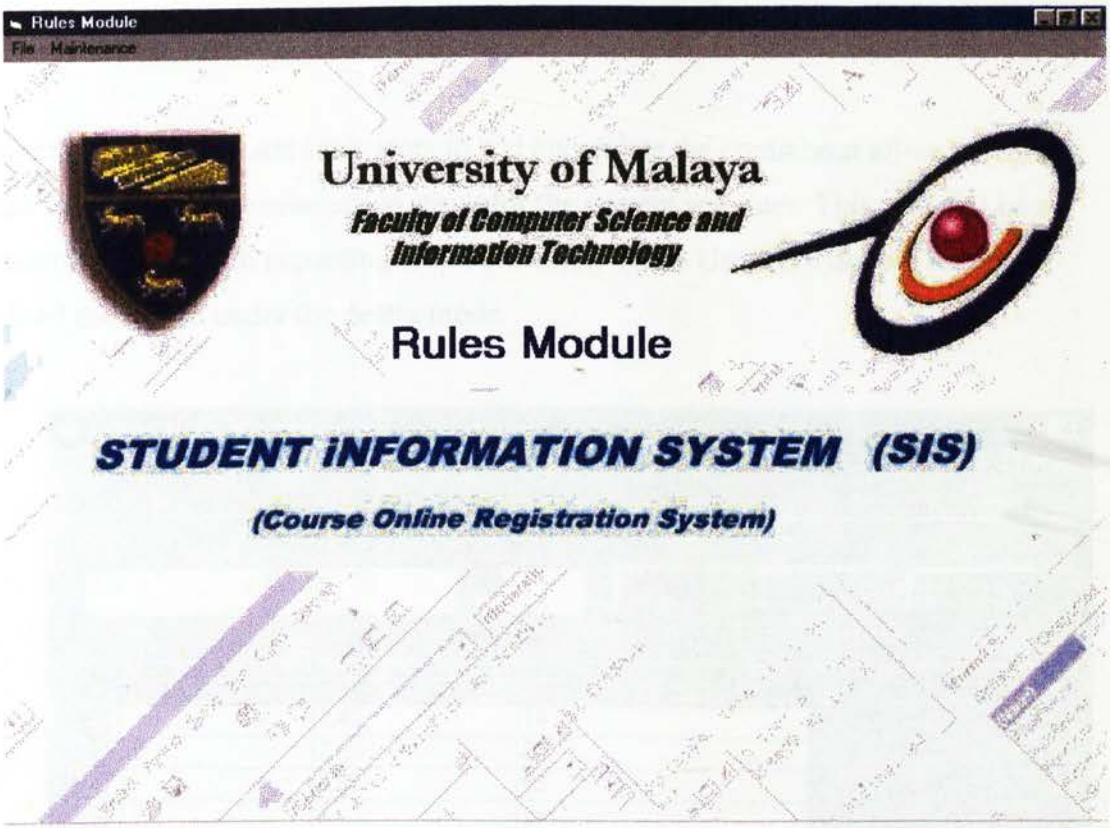

Figure 3.19: Rules Module Main Page

3.3.1 Credit Hour Maintenance

This function enables the administrators to add and delete the credit hour allow to register their courses base on the examination result for the current semester. This rule will be set by the administrators with according to the university rules. User may double click the grid to load the details under the delete mode.

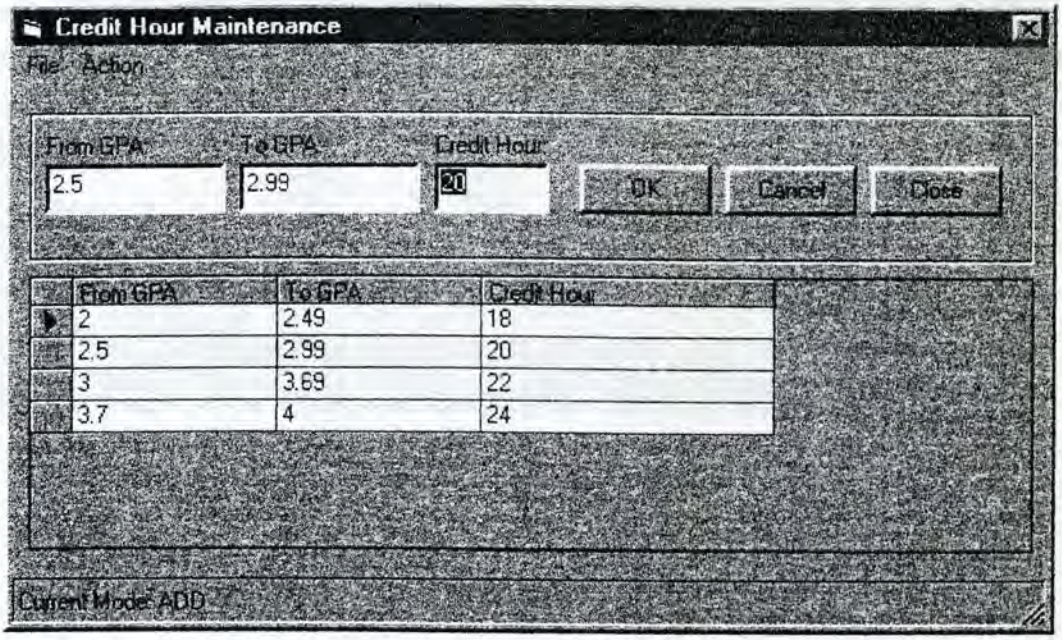

Figure 3.20: Credit Hour Maintenance

3.3.2 Submission Maintenance

This function enables the administrators to set the submission type. There are two types of submissions which are PPO1 and Add and Drop form. It is also use to activate or deactivate the submission of PPO1 form and Add and Drop form for the current semester. This rule will be set by the administrators with according to the university rules. User may double click the grid to load the details under the delete mode.

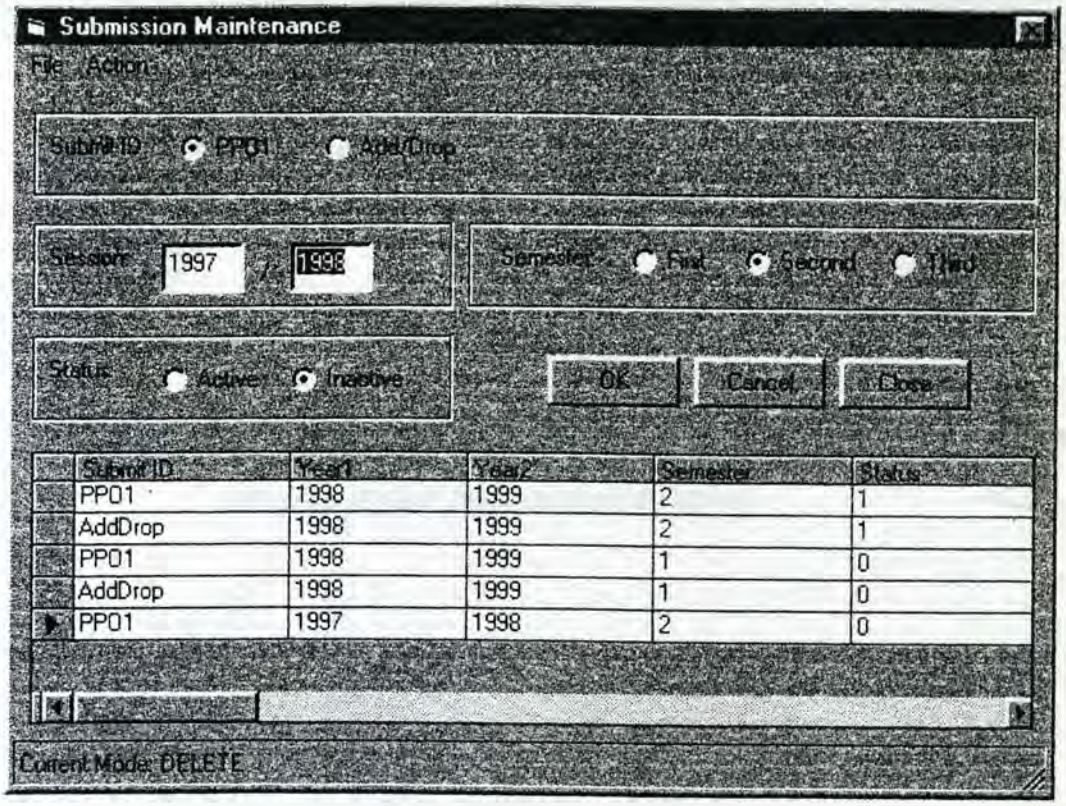

Figure 3.21: Submission Maintenance

3.4 Registration Module

Registration module consists of two functions which are student registration function and student registration approval function. Each function generally has three types of actions which are Add, Change and Delete mode. Figure 3.22 shows the main page for the Registration module.

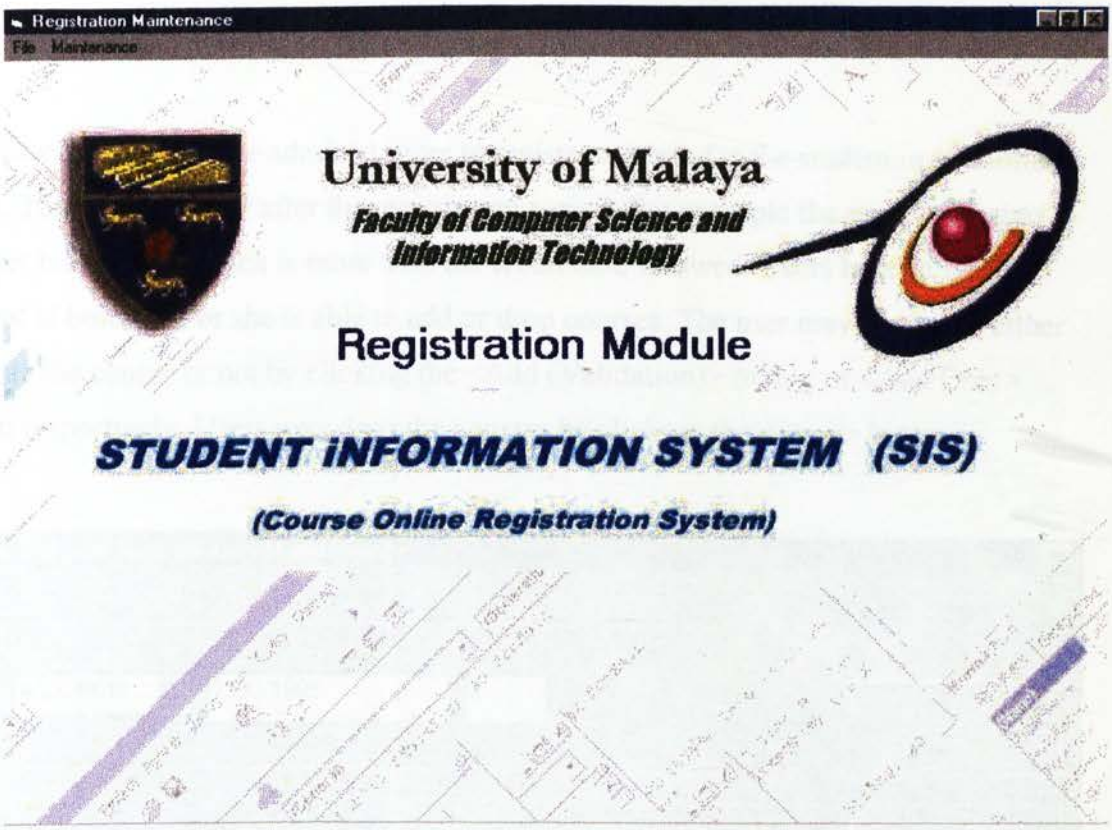

Figure 3.22: Registration Module Main Page

3.4.1 Student Registration Maintenance

This function enables the administrators to register courses for the student in abnormal cases. These cases occur after the registration period. For example the student want to register his courses which is more than the credit hour allowed. Users have to load the student id before he or she is able to add or drop courses. The user may choose to either validate the course or not by clicking the <Add (Validation)> button or <Add Only> button respectively. Users may drop the courses by clicking the <Drop> button.

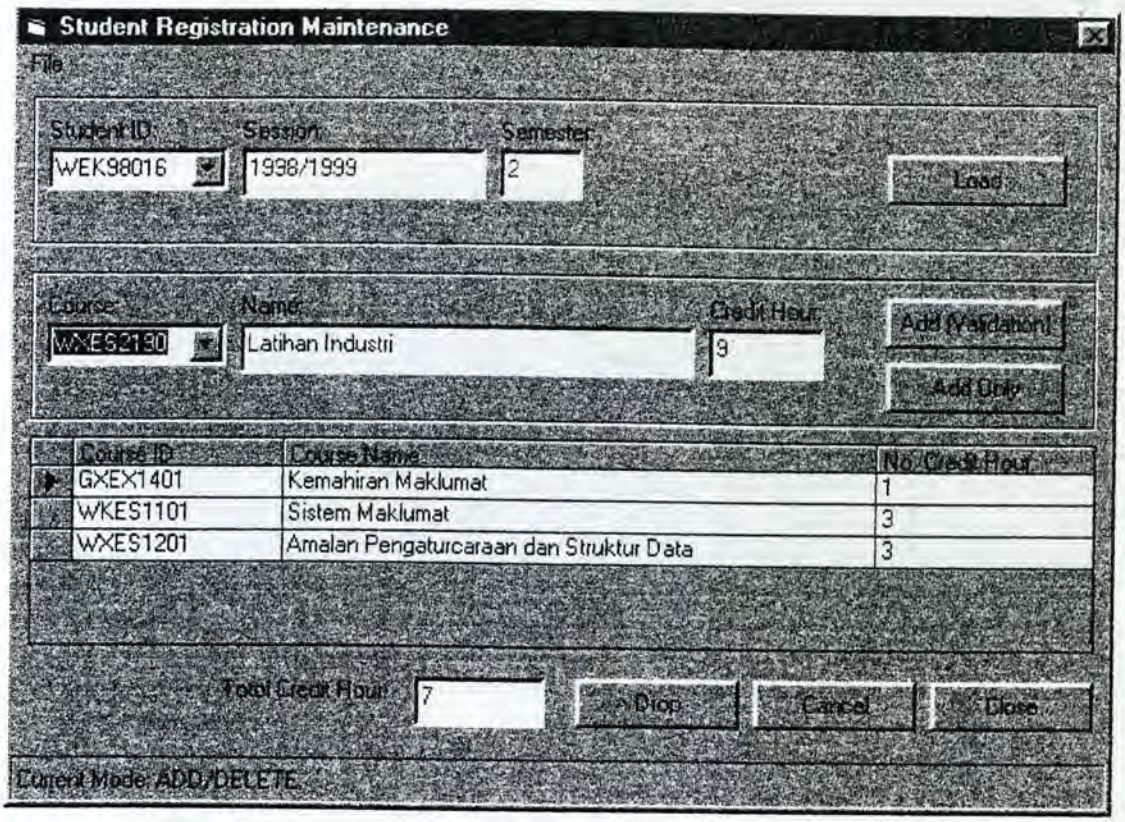

Figure 3.23: Student Registration Maintenance

3.4.2 Student Registration Approval Maintenance

This function enables the administrators to approve students' registration for the current semester. Clicking the <Post> button will approve the registration Users have to load the student id before he or she is able to approve the registration.

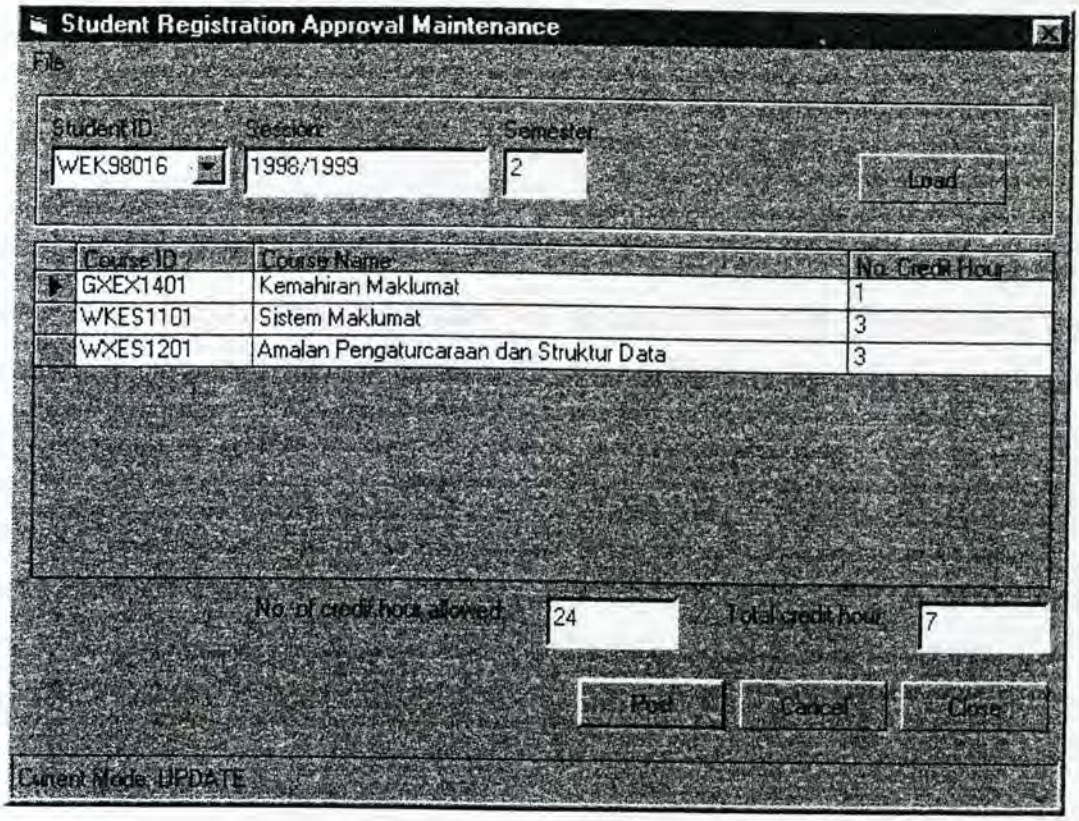

Figure 3.24: Student Registration Approval Maintenance

4.1 Online Registration

The following section will describe all the functions in SIS. This student section will be run online using Active Server Pages (ASP) technology. But before accessing this application, make sure that your computer meets the minimum hardware and software requirement.

Since student section is a fully web-based system, it does not need any setup at client side or any distributed workstations. All control will be done in the server. The first thing that you need to do is to start your web browser. A successful connection will cause web browser to display the home page of SIS system.

Before the student are allow to register their courses online, he or she is require to login as a valid user. All transactions will be performed by select the menu on the left frame section. Currently login identification and currently date will be display at the top portions of the web page. Figure 4.1 shows the default main home page of the SIS.

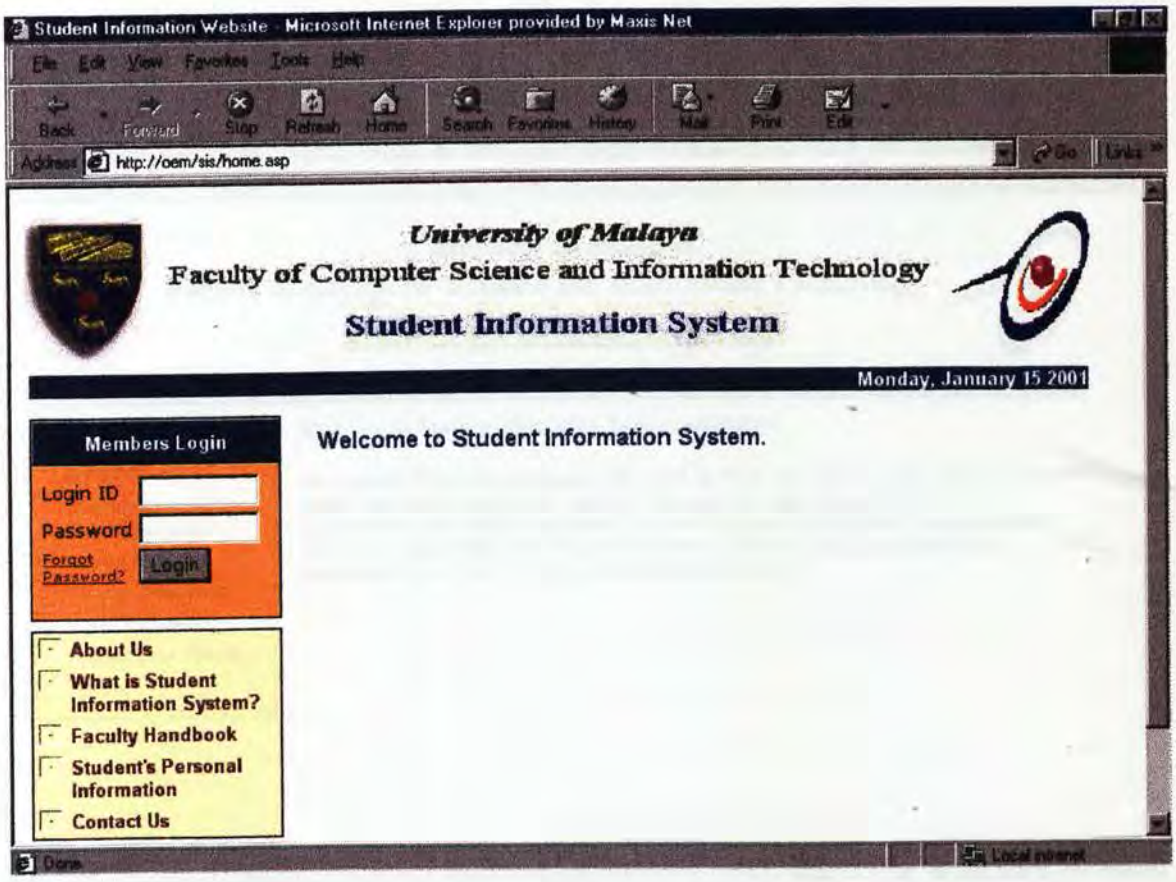

Figure 4.1: Default Home Page

Once the users have successfully login to the system, they will be directed to a student home page. This page is only accessible by undergraduate students. This page contains linking to the course registration for PPO1 form, course registration for Add/Drop form, change password, courses offered, view transcript and registration result. Students are allowed to register or submit their PPO1 form or Add/Drop form once only. Users have to register their courses online within the time scheduled by administrators. Figure 4.2 shows the student main page.

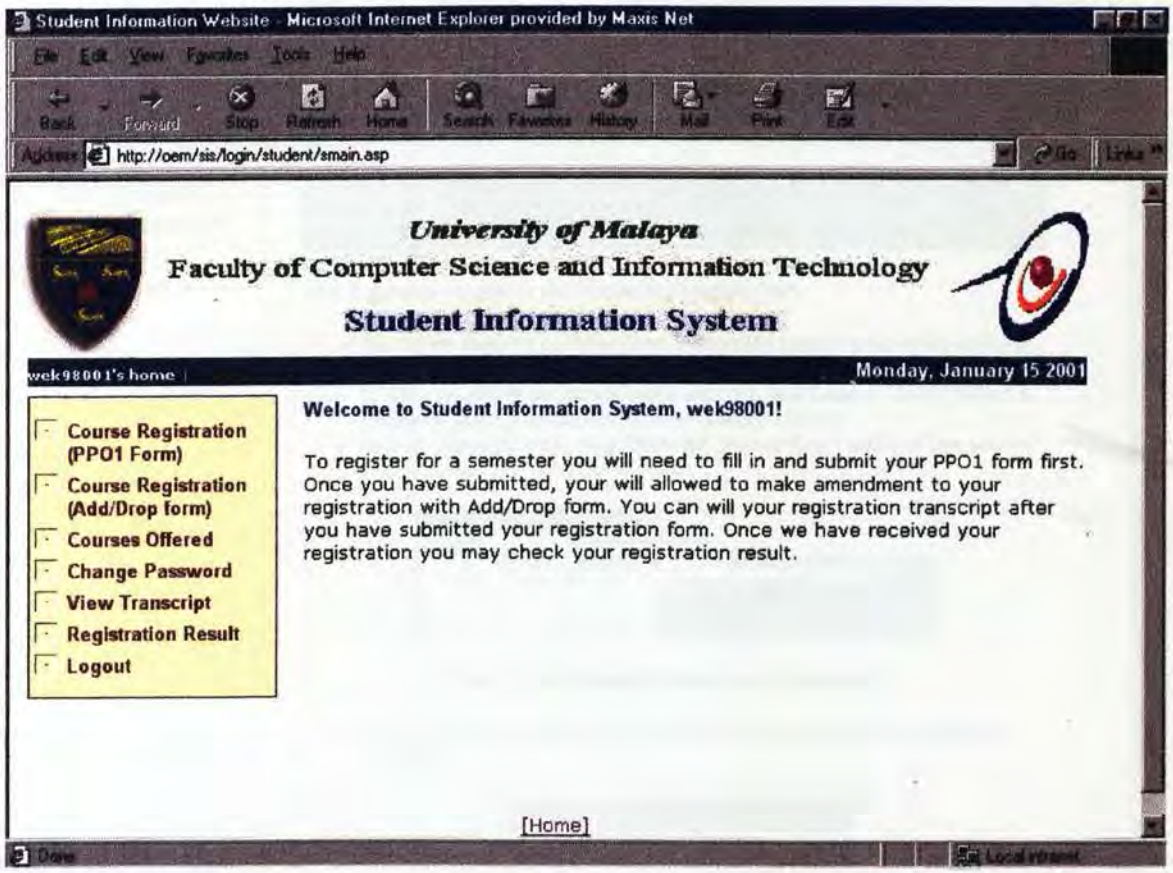

Figure 4.2: Student Main Page

In order to register the PPO1 form, users have to enter their course identification at the Add New Course and click <Add Course> button to register the course. This is show in the Figure 4.3. User may also select a course by clicking the <Select a course> navigation link. It shows all the courses that are available to register for the current semester as shown in Figure 4.4. Before the course is register, users will be asked to validate his or her course first. This step is shown in Figure 4.5. All the courses that have been registered will be displayed as shown in Figure 4.6.

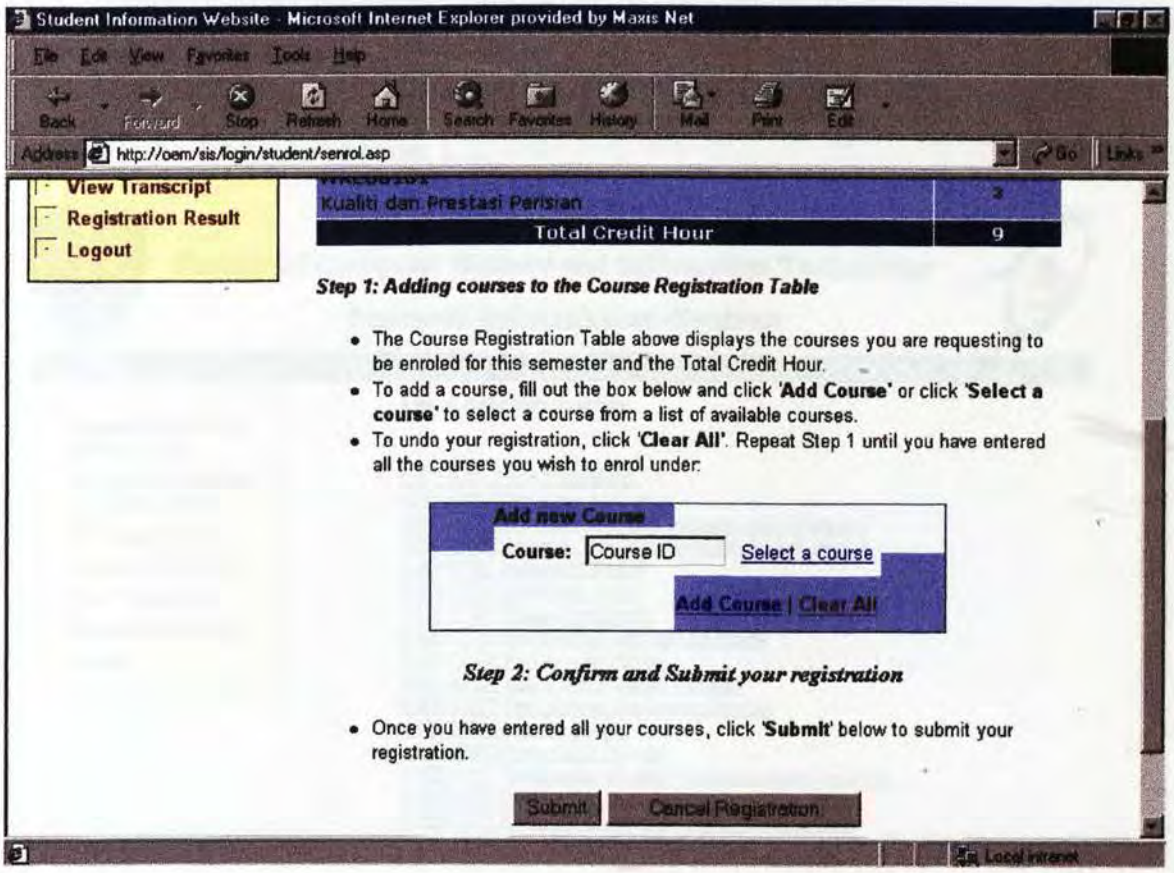

Figure 4.3: PPO1 Form (Upper part)

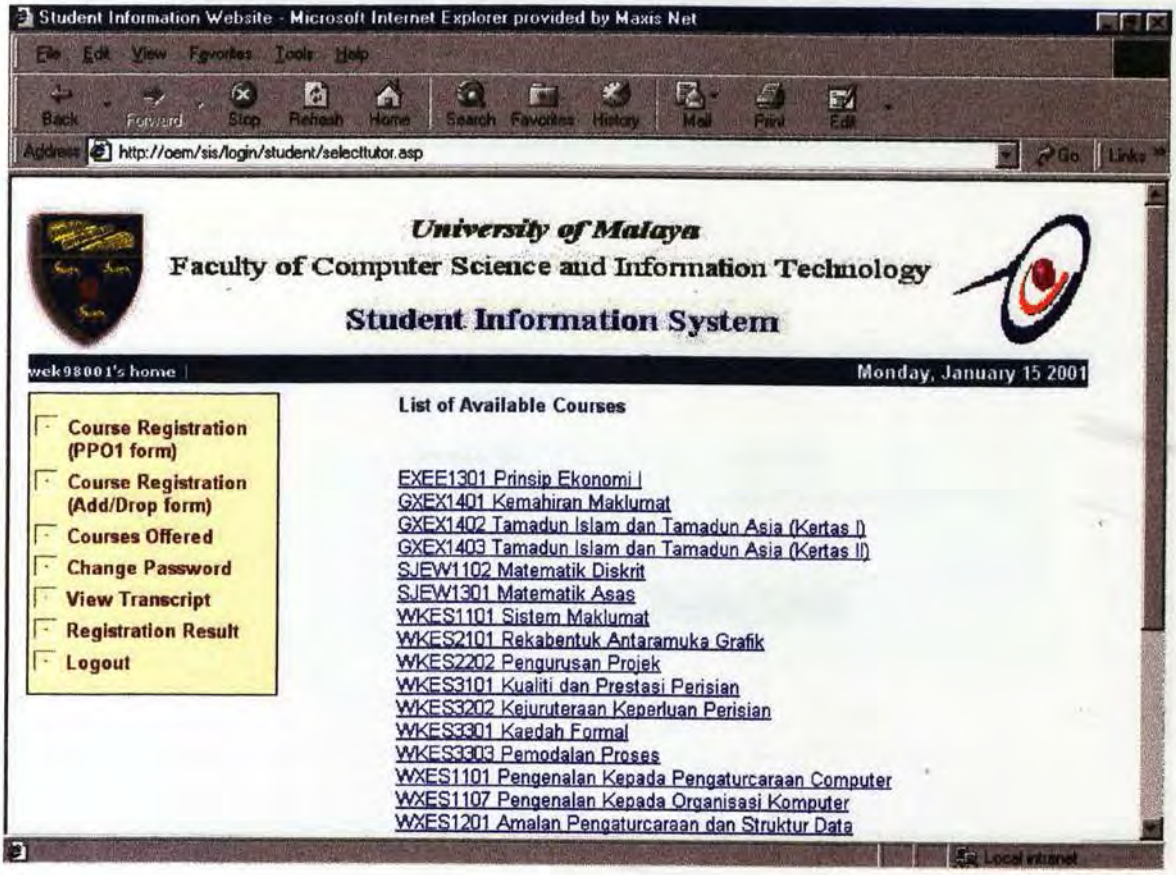

Figure 4.4: List of Offered Courses

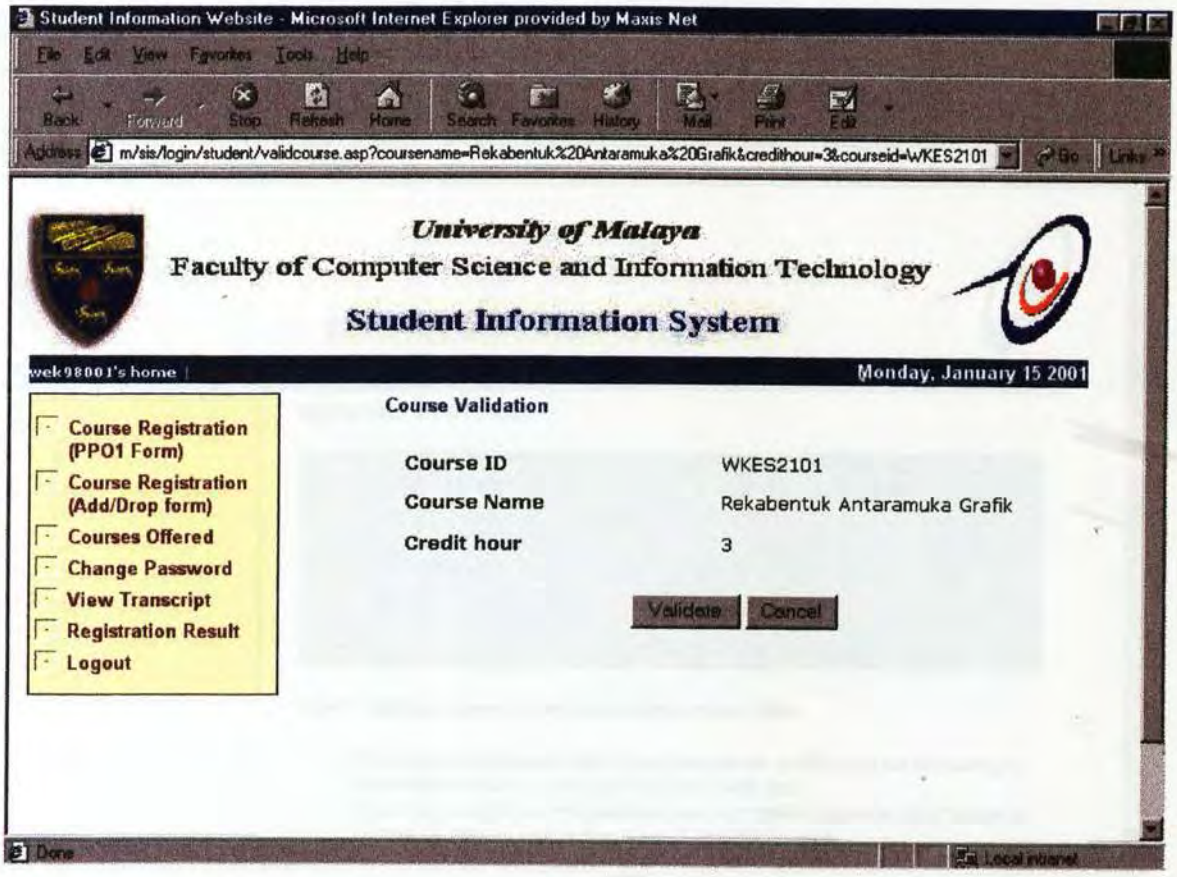

Figure 4.5: Course Validation

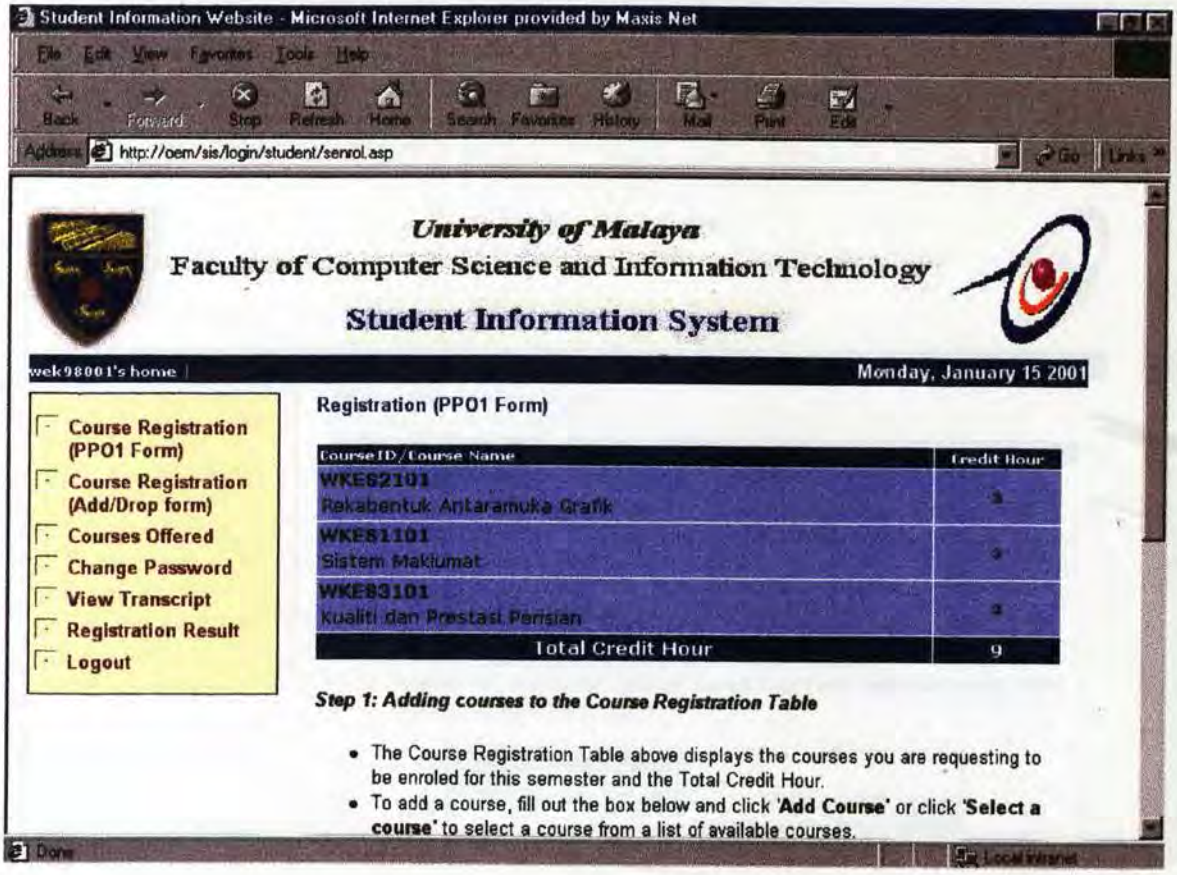

Figure 4.6: PPO1 Form (Lower part)

Registration for the Add/Drop form is follows the registration of PPO1 form steps. This is shown in Figure 4.7. After the form has been registered, users can view their transcript and check their registration status. There are three type of registration status which are success, fail and pending. Figure 4.8 shows the user's transcript while Figure 4.9 shows the registration status of the user's registration. User also can view their courses by clicking the linking in the frame on the left of the page as shown in Figure 4.10. User can change their password in the change password section as shown in Figure 4.11.

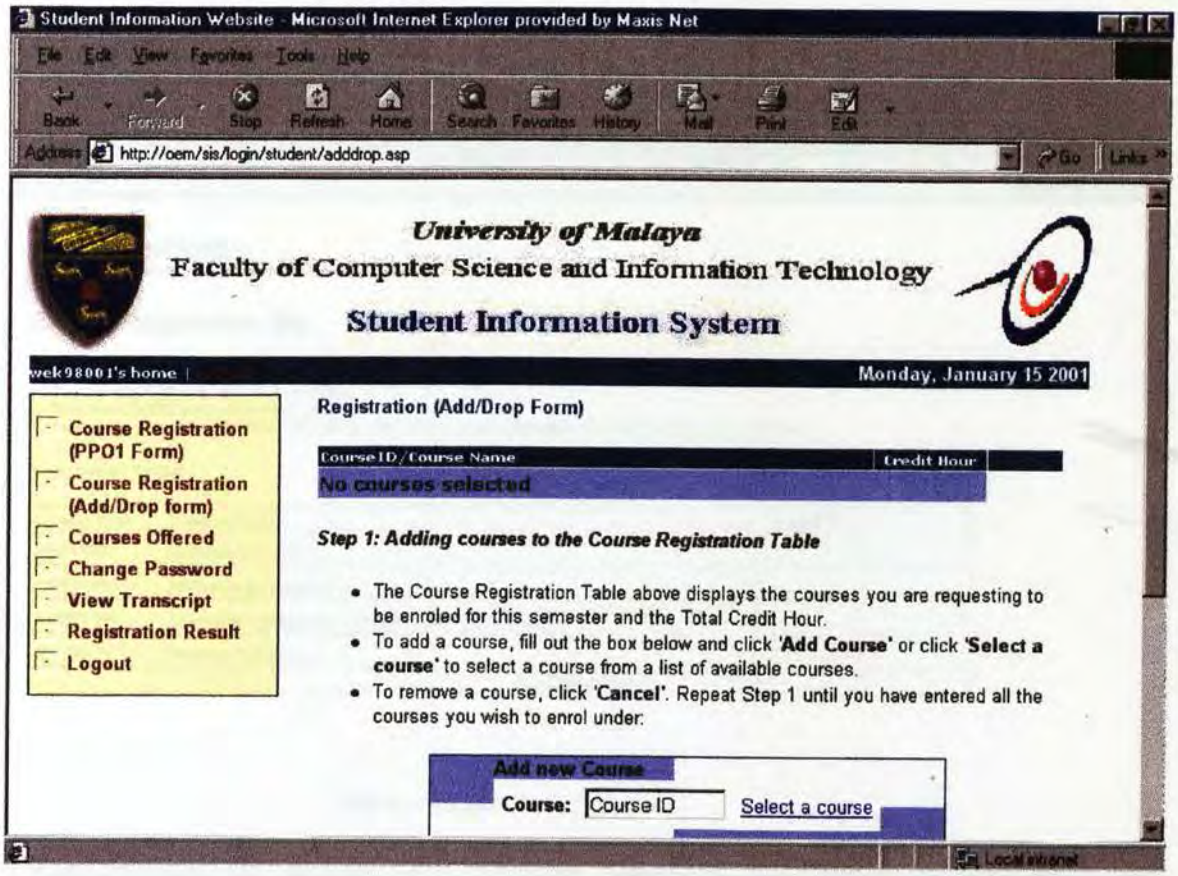

Figure 4.7: Add/Drop Form

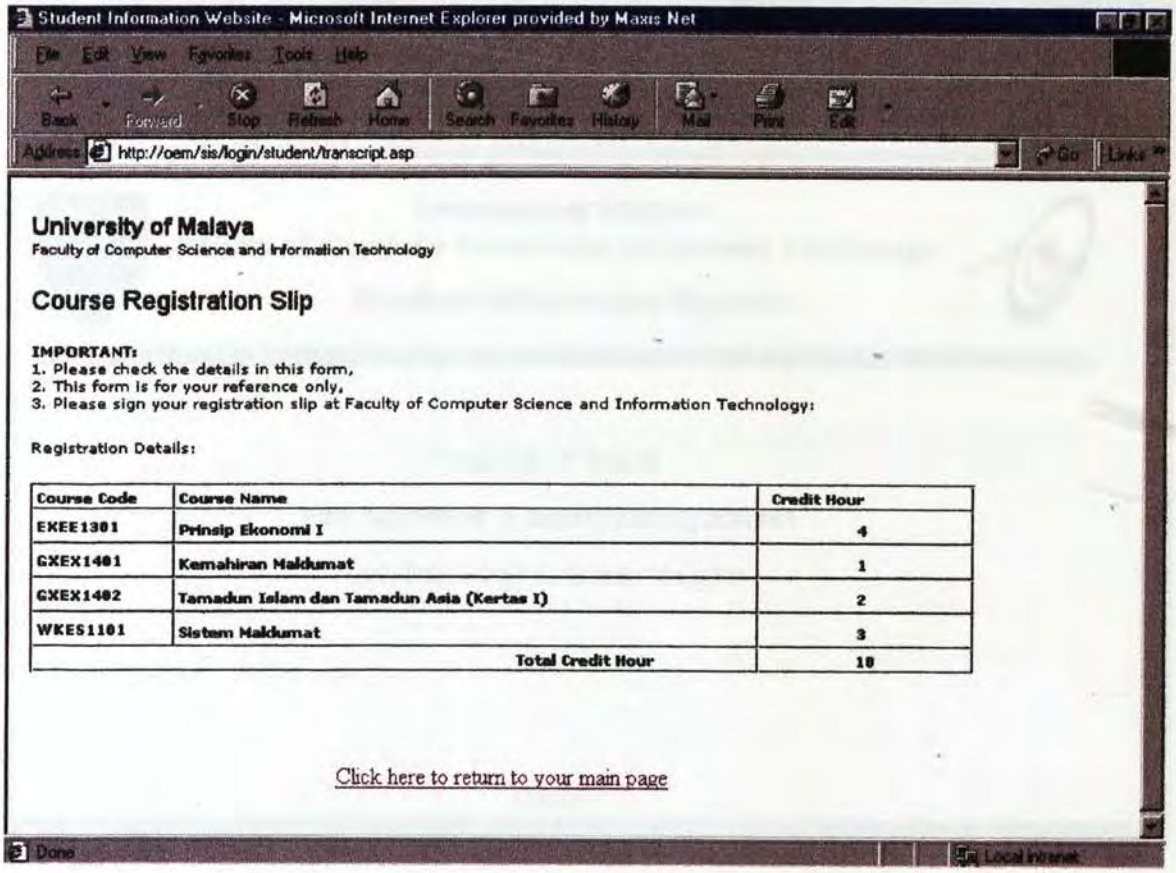

Figure 4.8: Registration Transcript

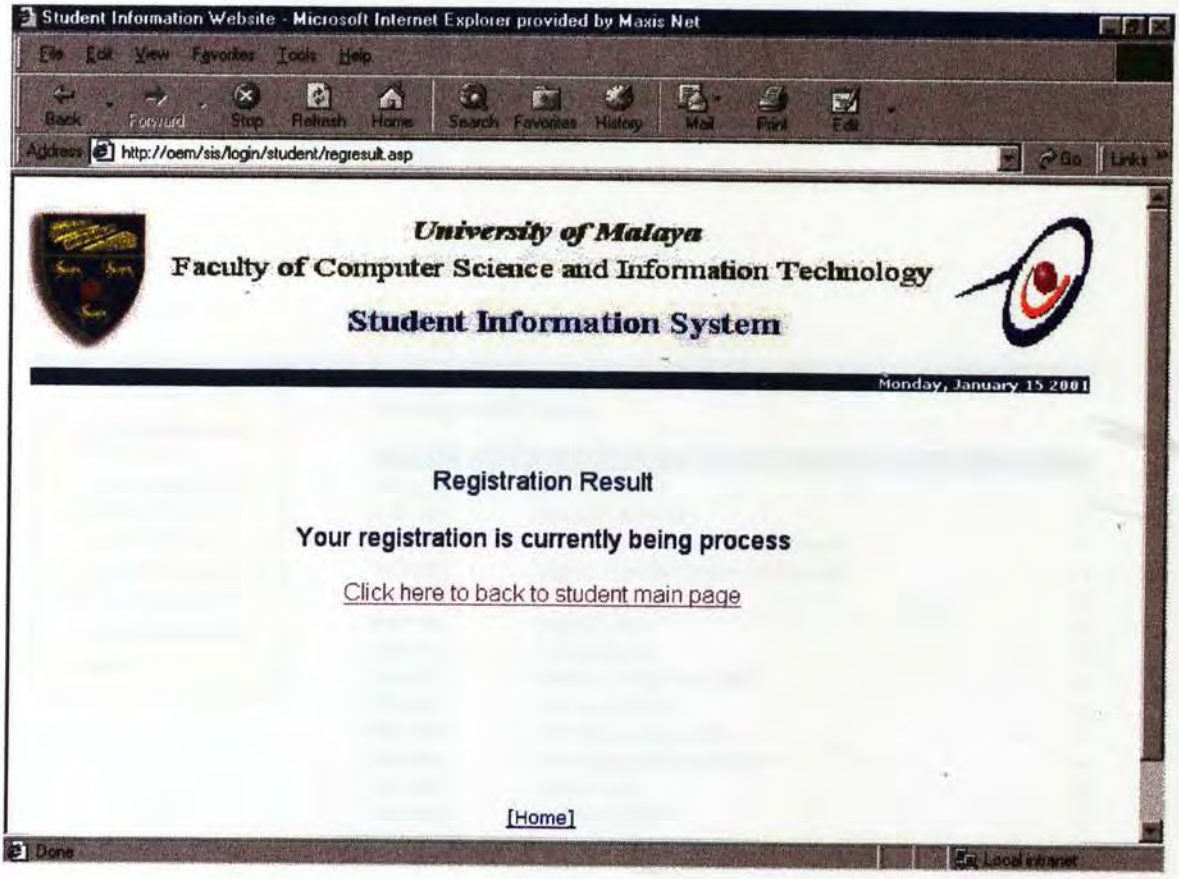

Figure 4.9: Registration Status

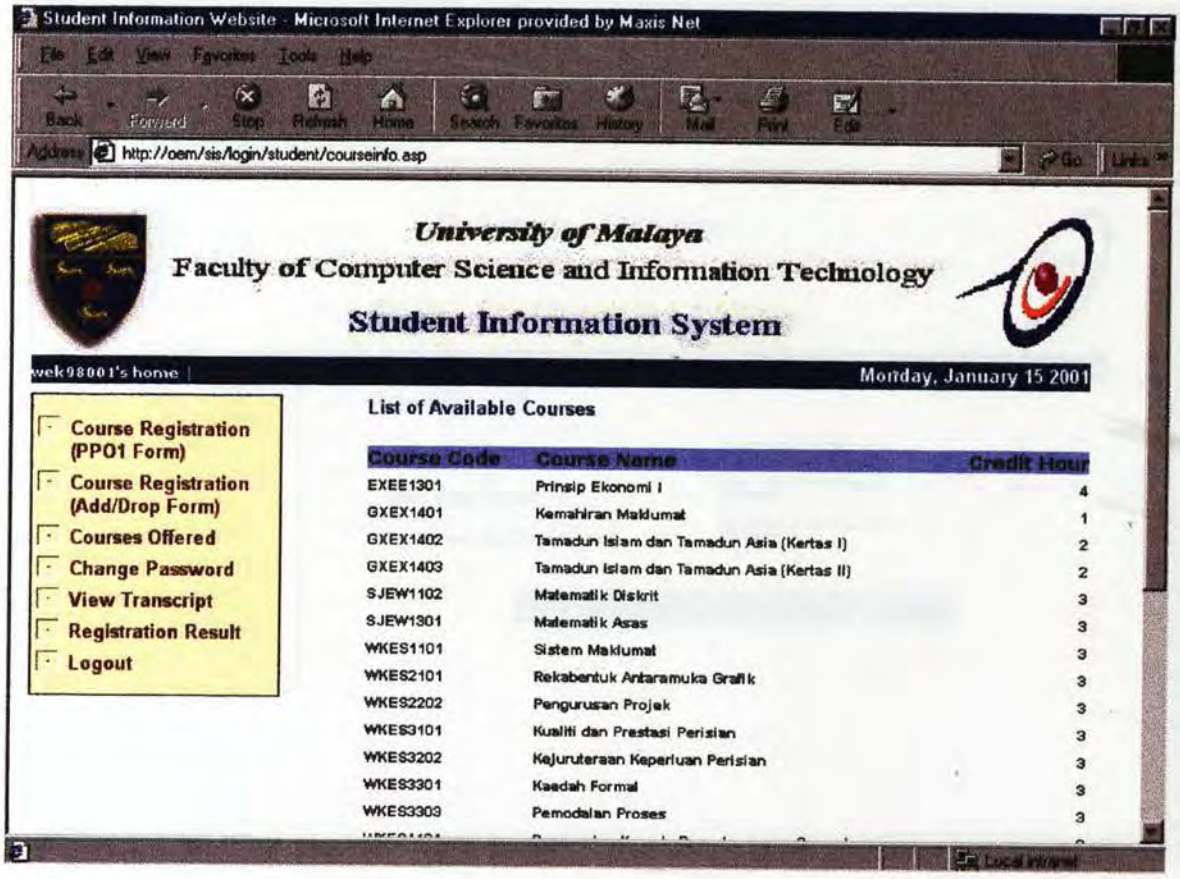

Figure 4.10: Course List

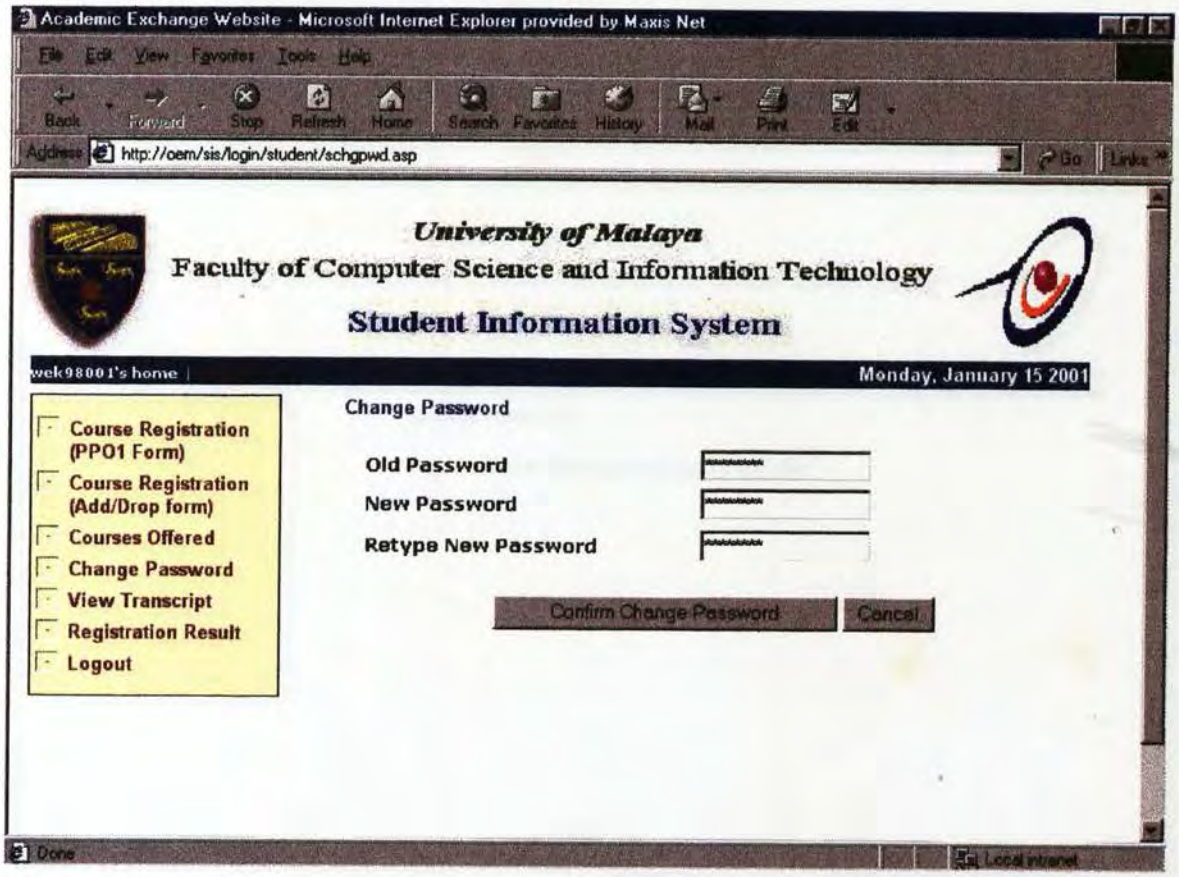

Figure 4.11: Change Password